STATEMAP
Mokena-SG

Surficial Geology of Mokena Quadrangle

Will and Cook Counties, Illinois

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Introduction

This surficial geologic map of the Mokena 7.5' Quadrangle is a part of a long-term geological mapping project (Curry and Grimley, 2001; Curry and Bruegger, 2014, Caron and Phillips, 2015;) in Will County. This map continues ISGS efforts in northeastern Illinois to map deposits at the land surface and in the subsurface down to bedrock to gain a better understanding of the complex geology left behind by repeated glaciations and associated flooding events. The Mokena Quadrangle is centered on the Valparaiso Morainic System, about 25 miles from the southern shore of Lake Michigan and southern Chicago (Fig. M1 [map sheet 2]). The largest communities in the area include the cities of Joliet (147,861, United States Census Bureau 2015), Lockport (25,175), and the villages of New Lenox (25,800), Orland Park village (58,619), Mokena village (19,923), Homer Glen village (24,395) and Frankfort (18,653). Interstate 80 traverses the south edge of the study area and the interstate 355 the west edge of this quadrangle.

Setting

The landscape was constructed during the last glaciation (Wisconsin Episode) between about 22,500 and 16,000 cal yr BP (Curry et al., 2014). Four moraines constitute the Valparaiso Morainic System: the Westmont, Wheaton, West Chicago, and Manhattan moraines (Willman and Frye 1970). Shallow valleys trending northeast-southwest crosscut the moraines and were likely formed by subglacial meltwater channels that evolved near the ice margin during downwasting of the ice (Menzies 1995). Bedrock comprises largely low relief, gently dipping, and resistant Silurian sedimentary rocks.

Mapping Methods

The surficial geology map is based primarily on interpretation of aerial imagery, LiDAR elevation data, boring records archived at the Illinois State Geological Survey, new outcrops and hand auger descriptions, and the Will County soils map (Hanson, 2004). The soil survey map details soil parent materials in the upper five feet, which in Will County are glacial and post-glacial deposits. Geologic contacts were verified at 89 sites by examining exposures along roads, creeks, and ditches, and by sampling with a hand auger. The subsurface data include detailed studies of 25 stratigraphic test holes including 8 stratigraphic test holes drilled by the Illinois State Geological Survey (ISGS), 109 water well logs, and 46 bridge and foundation (engineering) borings from the Will County Highway Department. Positions of some map boundaries and descriptions of some units were modified based on geotechnical log and test hole descriptions, from the field sites, and from other archival data. Locations of the water well logs and geotechnical borings were confirmed by plat books of land ownership, aerial photography, tax records, and site visits. The records for all data sources are on file at the ISGS Geological Records Unit. We acquired a total of 343 feet of core at 6 locations using hydraulic push methods, and a total of 280 feet of core at two locations using continuous wireline coring. The two wireline core reached bedrock and have natural gamma-ray logs. Earth electrical resistivity (EER) totaling 1.3 miles was acquired along two lines within the Spring Creek drainage. The first line (fig. 1), acquired along W 167th St crosses Spring Creek in portions of Messenger Marsh Preserve of Will County. The second line (fig. 2), acquired along South Meader Road gradually ascends a ridge of the Valparaiso morainic system south of Spring Creek. Particle size distributions (Table 1) were determined by laser diffraction on 30 samples from test holes and 10 samples from outcrop and hand auger holes. Finally, elemental analyses by Energy Dispersive XRF was performed on 20 samples from test holes. Sample testing was completed in ISGS laboratories.

Geology and Surficial Deposits

The glacial stratigraphy of the Mokena 7.5' Quadrangle is dominated by sorted deposits of the Mason Group and glacigenic diamicton of the Wedron Formation (Hansel and Johnson 1996; fig. 3). These units attain thicknesses of more than 185 feet (56.4 m) along the Spring Creek valley. Older units of the Wedron Group (Tiskilwa Formation and Batestown Member, Lemont Formation) are absent.

Bedrock Surface

Silurian-age rocks at the bedrock surface are composed of light gray, fine-grained dolomite and limestone. Bedrock highlands mainly in the southeast descend gently from about 600–625 feet to 650–675 feet in the northwest (fig. 4). Silurian rocks commonly exceed 250 feet in thickness, except where they have been deeply eroded. The glacial sediments contain thick deposits of diamictons, silty-clayey rhythmites and, sand and gravel in a deeply buried valley which extends northeastward from Joliet for a distance of at least 10 miles (Cross section D-D' [map sheet 2]). This bedrock valley extends northeastward from Joliet and coincide with the present valley of Spring Creek. The channel along the Spring Creek of the bedrock valley is about 1 mile wide, have relatively steep walls, and average 150 feet in depth (fig. 5).

Glacial

Based on a LiDAR-derived DTM, six sediment landform assemblages were mapped in upland areas (Map sheet 1). The lowermost unit is an unnamed tongue of sand and gravel below the Yorkville Member, h(l-y). This outwash unit consists of interbedded brown to gray fine gravel to sandy gravel, and it is typically less than 20 feet thick. The Yorkville Member (Lemont Formation; l-y) is a gray, fine textured diamicton that contains lenses of gravel, sand, silt, and clay. It is typically 45 feet but up to 80 feet thick. The Yorkville Member is identified at the surface in the southwestern part of the quadrangle. The Haeger Member (Lemont Formation) diamicton is yellowish brown, coarse-grained, friable and high dolomite content. This unit is greater than 65 feet thick in some places. The extent and the thickness of this diamic-

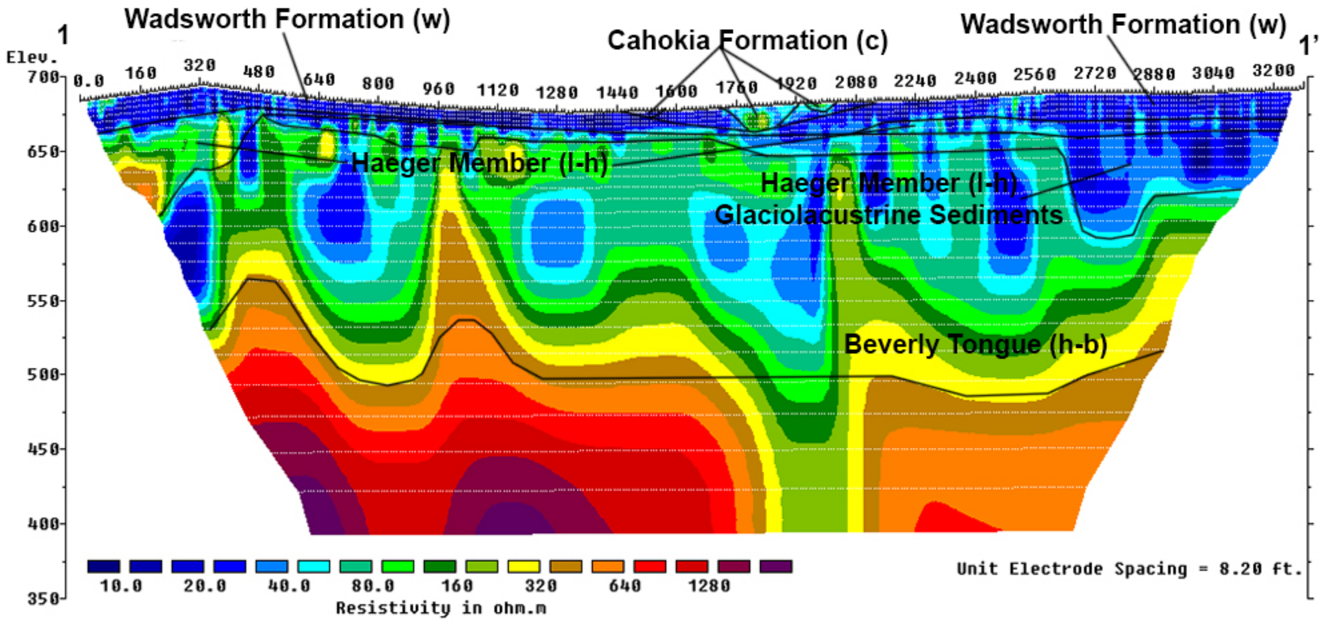

Figure 1 The first line was acquired along the south side of 167th St from about 100 m east of a major power line and continued to S Bell Road, a distance of 1000 m. The west part of the line crossed a low hill before descending into the bottom land of Spring Creek and Messenger Marsh. A low rise marked the eastern edge of the swamp, and the line ended in hummocky terrain east of the marsh. Four distinct and one gradational resistivity layers are apparent on this profile: a shallow low-resistivity layer (about 20 ohm-m) overlies a discontinuous moderately high-resistivity layer (80 to 160 ohm-m). Where the high-resistivity layer is present, it is underlain by a second relatively low-resistivity layer (40 to 60 ohm-m) above the high-resistivity bedrock (greater than 160 ohm-m). The boundary between the lower low-resistivity layer and the high-resistivity bedrock is gradational. It is likely that the gradational resistivity is caused by the sand and gravel deposit of the Beverly Tongue (Henry Formation, h-b) on the bedrock. The shallow high-resistivity layer is absent (or very thin) on the east end of the profile, suggesting that the glaciolacustrine sediments of the marsh fill a relatively thick basin beneath the east end of the profile.

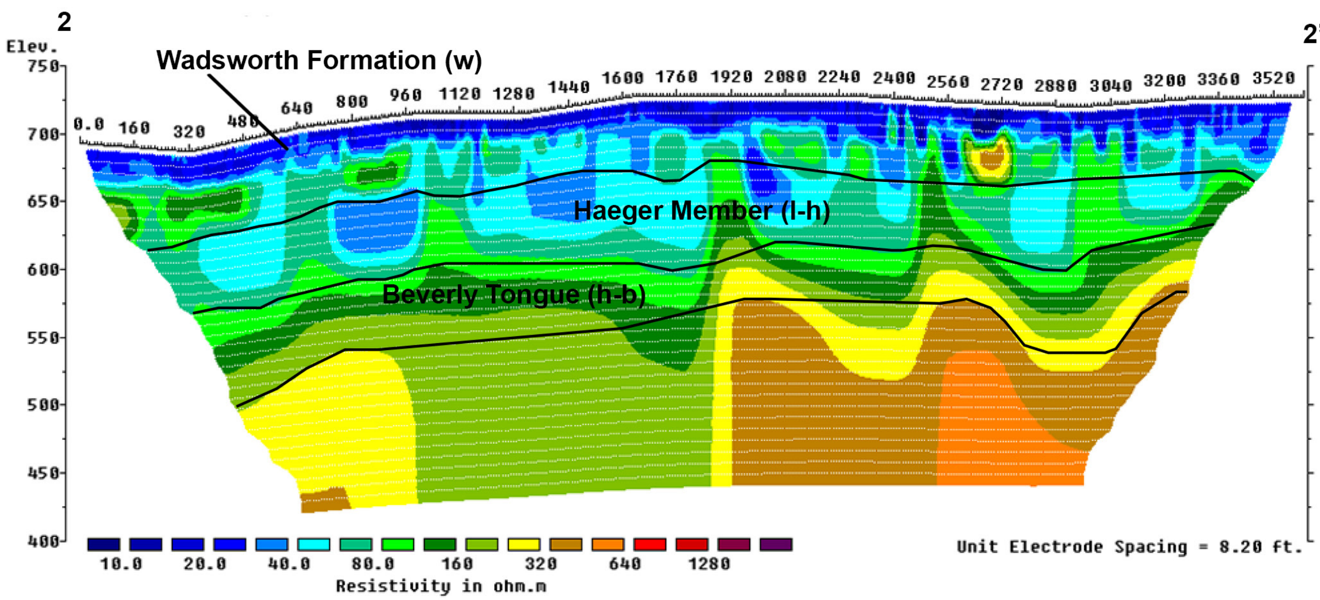

Figure 2 The second line was acquired along the west side of Meader Road from the intersection with West Chicago-Bloomington Trail to the south line of Homer Township (map sheet 1). The profile begins near Spring Creek and gradually ascends the rough topography of the Wheaton Moraine. The resistivity profile is very similar to the 167th Street profile. Four distinct and one gradational resistivity layers are apparent on this profile: a shallow low-resistivity layer (about 20 ohm-m) overlies a discontinuous moderately high-resistivity layer (80 to 160 ohm-m). These shallow layers are underlain by a second relatively low-resistivity layer (40 to 80 ohm-m) above the high-resistivity bedrock (greater than 160 ohm-m). Although the shallow high-resistivity layer is discontinuous, it can be traced across the entire profile. The boundary between the lower low-resistivity layer and the high-resistivity bedrock is gradational. It is likely that the gradational resistivity is caused by the sand and gravel deposit of the Beverly Tongue (Henry Formation, h-b) on the bedrock. The deep high-resistivity layer, interpreted to be bedrock, has significantly higher values on the south half of the profile compared to the north half.

Table 1 Summary of particle size of selected map units

Units	Sand (%)	Silt (%)	Clay (%)
Grayslake Peat, gp	8-11	45-53	36-41
Cahokia Formation, c	29-38	39-47	20-28
Equality Formation, (si)	10-13	49-58	25-29
Equality Formation, (f)	6-10	60-64	30-32
Henry Formation, h	51-61	32-37	12-16
Henry Formation, Beverly Tongue, h-b	55-64	28-35	8-11
Henry underlying Yorkville Member, h(l-y)	52-59	22-30	9-13
Wadsworth Formation, w	12-21	48-52	29-32
Lemont Formation, Haeger Member, l-h	33-38	44-49	13-15
Lemont Formation, Yorkville Member, l-y	8-11	42-45	46-49
Silurian bedrock	ND	ND	ND

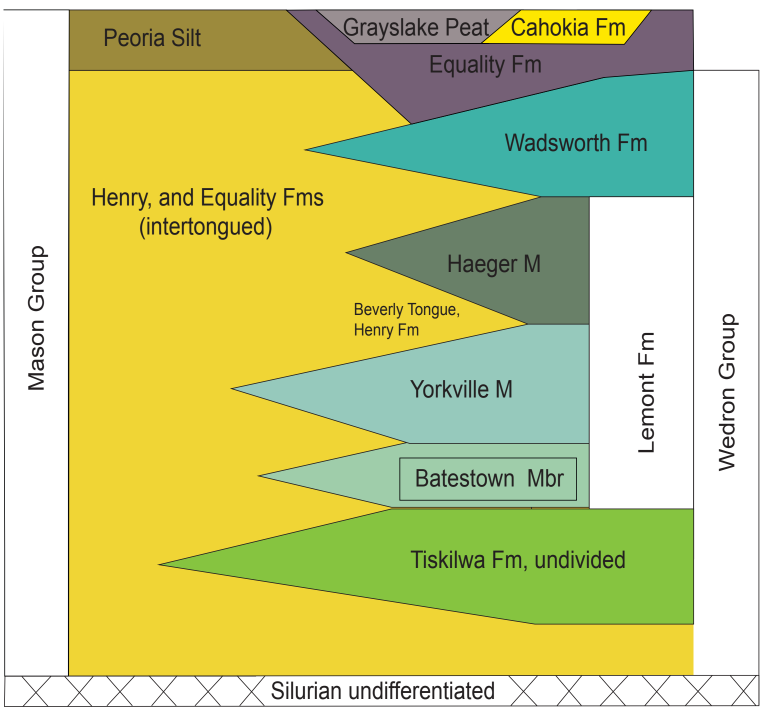

Figure 3 Lithostratigraphy of Will County and environs (Caron and Curry, 2016). The Batestown Member and the Tiskilwa Formation have not been identified in the Mokena 7.5' Quadrangle.

ton is difficult to identify beneath the southwestern Lake Michigan area because of limited exposure, but the Haeger Member was clearly identified in the Mokena Quadrangle in archived well and boring records. This diamicton was clearly differentiable north of the Hickory Creek valley but has a patchier distribution south of the valley. This member of the Lemont Formation is also associated with the underlying Beverly Tongue of the Henry Formation. The Beverly Tongue (h-b) is regionally the thickest and most continuous subunit of the Henry Formation. The fill along the Spring Creek contains a large proportion of sand and gravel of the Beverly Tongue. At places the lower part of the fill contains finer-grained material than the upper part. The sand and gravel is overlain at places by the diamictons of the Haeger Member of the Lemont Formation and by the Wadsworth Formation that contain a high percentage of silt and clay. On the quadrangle, the uppermost diamicton unit has a heterogeneous lithology that is locally consistent with the Wadsworth Formation (w). The Wadsworth Formation is an extensive surficial clay-rich stratigraphic unit in northeastern Illinois. It is interpreted commonly as interstratified clayey till and lacustrine sediment (Hansel and Johnson,

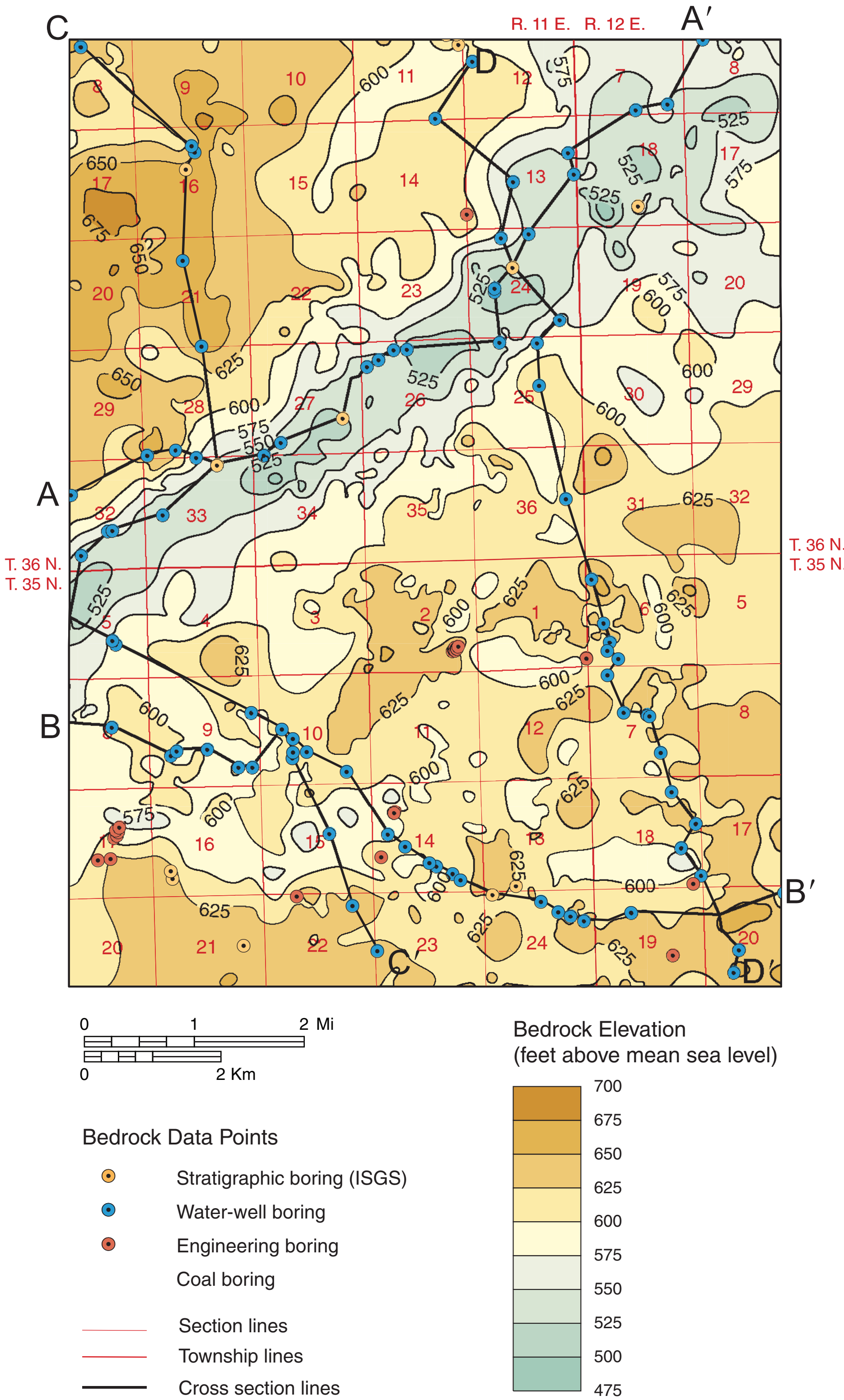

Figure 4 Bedrock topography of the Mokena Quadrangle. Map scale is 1:100,000.

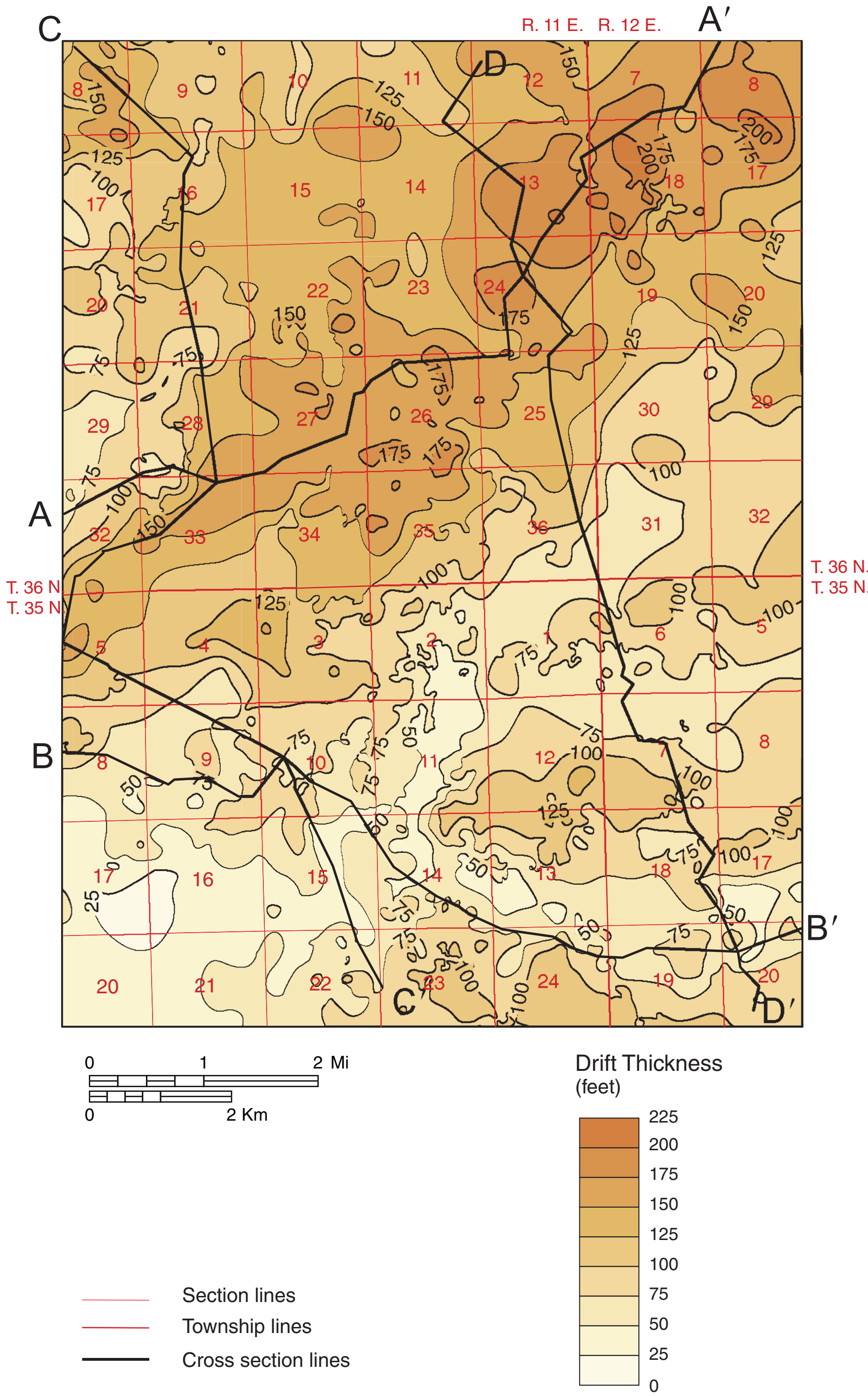

Figure 5 Drift thickness of the Mokena Quadrangle. Drift includes all the unconsolidated sediments above bedrock (e.g., till, alluvium, outwash). Map is 1:100,000.

1996). In the Mokena Quadrangle, this unit is more than 125 feet thick.

Postglacial sediment

Deposits of silt and clay, peat, sandy gravel, and sand overlie the glacial units, filling the valleys throughout the mapped area as well as many low spots scattered across the uplands. Alluvium comprised of fine-grained floodplain and coarser-grained active channel deposits are here undifferentiated within the Cahokia Formation (c). Bridge boring data indicate that the floodplain unit is as much as 20 feet thick in some places. The Grayslake Peat (gp) consists of peat, muck, organic silt and clay, and interbedded sand, and is less than 10 feet thick. The Grayslake Peat was deposited in depressions and at the toes of slopes. The silt and clay glaciolacustrine sediment (glacial and post-glacial) is assigned to the Equality Formation (e(f) and e(si)). The glaciolacustrine nearshore sediments (e(si)) are composed primarily of silt, silty sand and sand. The deposits are relatively thin (less than 10 feet thick) and are typically discontinuous in Will County. However, in the Mokena Quadrangle, Equality Formation deposits are quite extensive in the Spring Creek valley in Homer Glen and Orland Park. The glaciolacustrine deep water sediments (e(f) are composed of clay, silt, silty-clayey rhythmites. This unit is generally <20 feet thick and was deposited in ice-dammed lakes during late-glacial ice retreat and stagnation.

Important Findings

- Three glacial diamicton units were identified: The Yorkville and Haeger Members of the Lemont Formation, and the Wadsworth Formation. The uppermost diamicton unit is the Wadsworth Formation which forms the Valparaiso Morainic System. The Yorkville Member was identified at the surface in the southwestern part of the quadrangle.

- A buried valley extending northeastward from Joliet for a distance of at least 10 miles was identified along the Spring Creek valley. The glacial sediment infill is more than 150 feet thick with thick deposits of sand and gravel. The sand and gravel is an aquifer associated with the Beverly Tongue of the Henry Formation and exceeds 100 feet in thickness. This tongue of outwash was consistently found across the Mokena Quadrangle between the Wadsworth Formation and the Haeger Member of the Lemont Formation.

- The Haeger Member (Lemont Formation) diamicton is known for its relatively coarse particle-size distribution (from boulders to silt) and high dolomite content, and also by the difficulty in tracing this unit in the subsurface where it pinches out to east and south of the Lemont section. In the Mokena Quadrangle, this diamicton was clearly differentiable north of the Hickory Creek valley but has a patchier distribution south of the valley.

- Most of the northeastern portion of the quadrangle is covered by glaciolacustrine sediments of the Equality Formation. They were deposited in moraine-dammed lakes during glacial retreat. They mostly occur in an elongated depression of the Valparaiso Morainic system. They reach 2 mi long and 1 mi wide. Many of the lake deposits were unrecognized before the mapping project.

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