Glacial Lithostratigraphy of the Tully Valley
Onondaga County, New York

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Introduction

The glacial history of the Tully Valley and the surrounding region (Figure 1) has received the attention of the New York State Geological Association through field trips spanning almost the last 35 years. The area's spectacular glacial topography has been featured on NYSGA trips led by Muller (1964), Grasso (1970), Kirkland (1970), Hand and Muller (1972), Andrews and Jordan (1978), Hand (1978, 1992), and Mullins et al. (1991). The 1997 NYSGA trip to the Tully Valley will continue to rely heavily upon the ideas and interpretations found in those guidebooks for a regional picture of the area's glacial heritage. However, mudboils, landslides, subsidence, and other phenomena in the Tully Valley (see Kappel et al. (1996), and this guidebook) have necessitated a shift from an emphasis on the landforms (or morphostratigraphy) to one that focuses more on the nature and origin of the sediments (or lithostratigraphy). This effort has already been greatly advanced by the publication of Kappel et al. (1996). In addition, recent surficial mapping at a 1:24,000 scale accompanied by sedimentologic studies of new exposures and compilation of available subsurface data from the area north of the Tully Moraine (Pair, 1995; Pair and Gomes, 1997) has hopefully clarified specific parts of the glacial history. What follows is a summary of the lithostratigraphic framework developed for use in understanding the nature, distribution, and potential hazards associated with sediments found in the Tully Valley.

Pleistocene Deposits

Glacial Till

Glacial till in the Tully Valley is comprised of a mixture of unsorted to poorly sorted clay, silt, sand, to boulder sized diamict. It may be highly compacted and is clay-rich in the floor of the valley. Till can be 2-20 meters thick in the uplands and on the sides of valleys, and greater than 30 meters thick in the floor of the valley. The surface of this unit is drumlinized in the uplands northwest of the Tully Valley.

Ice Contact Sand and Gravel

A unit of coarse to fine sand and gravel, poorly to well stratified and/or sorted, was deposited adjacent to the ice margin. The thickness of these sediments is variable (2-20 meters) and they are commonly associated with kame and kettle topography like that found on the surface of the Tully Moraine (Figure 2). Similar materials are also found at several other locations to the north on valley slopes and adjacent uplands where the ice margin stabilized temporarily and built ice-marginal landforms.

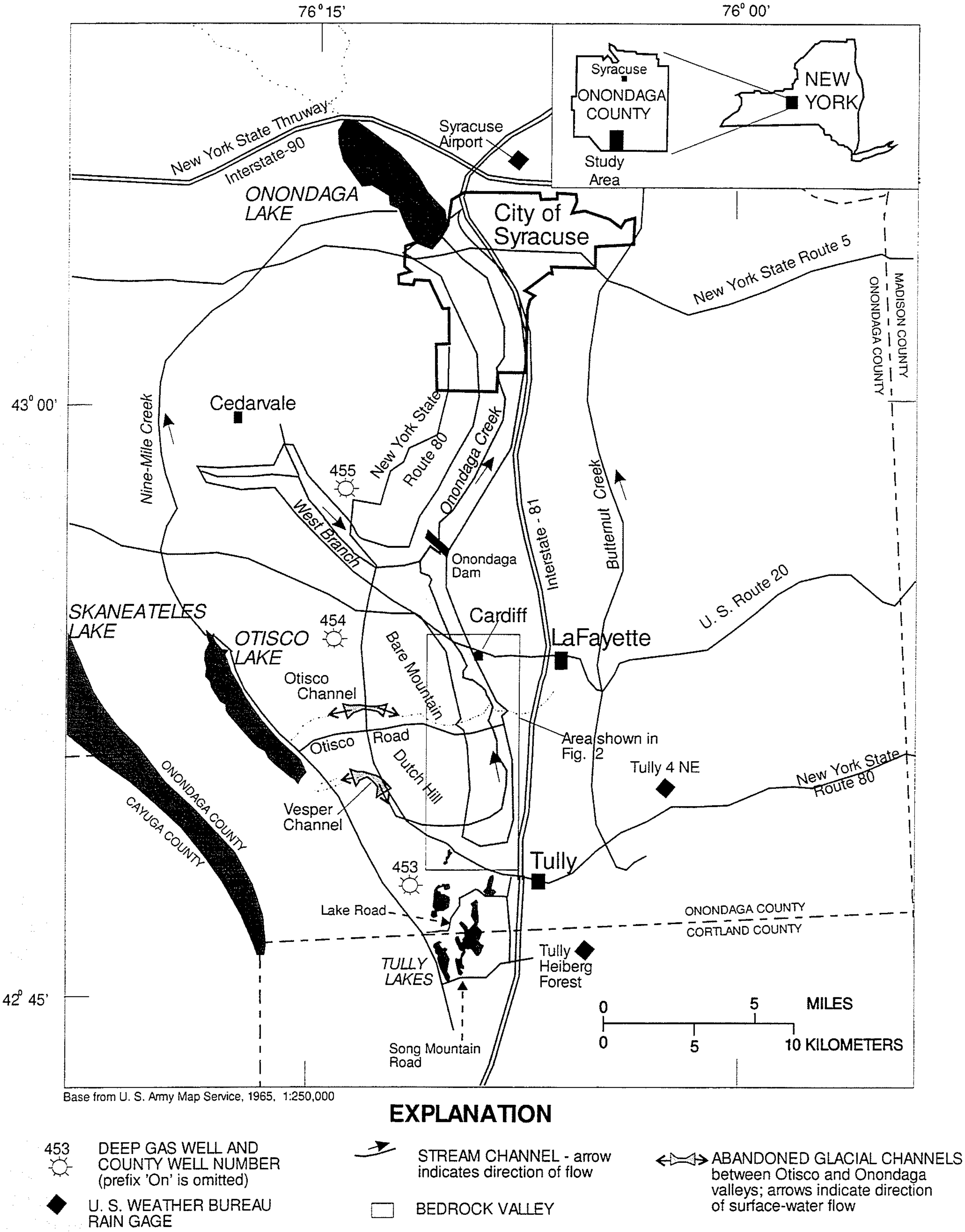


Figure 1. Location and pertinent geographic features of the Tully Valley, in southen Onondaga County, N.Y. (From Kappel and others, 1996, fig. 1.)

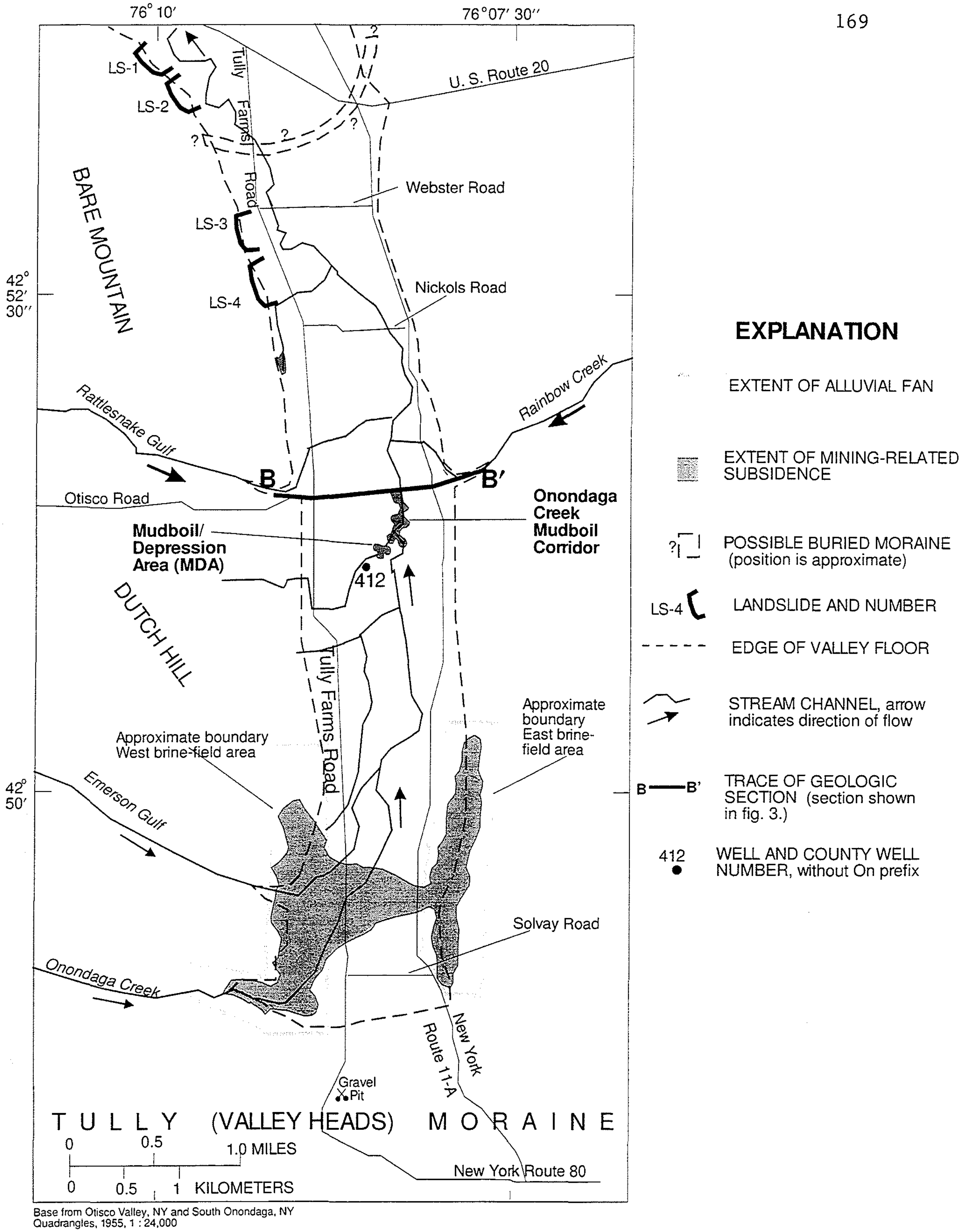


Figure 2. Principal geographic features of the Tully Valley showing glacial stratigraphic well On-412, brinefield areas, landslides, mudboil areas, and geologic section B-B′ (Geologic section shown in fig. 3. From Kappel and others, 1996, fig. 2)

Glaciolacustrine Silt and Clay

Laminated silt and clays found in the Tully Valley were deposited in proglacial lakes formed by the impoundment of meltwater between the Tully Moraine and the receding ice margin. Their thickness ranges from 3-100 meters depending on location in the valley. The clay fractions of these sediments are characteristically red in color and can include both isolated lenses of sand and gravel as well as pebbly, weakly graded diamictons interpreted as underflow (turbidites, debris flows etc.) deposits that emanated from the adjacent ice margin, moraine slopes, or valley walls. Well logs suggest that these fine-grained sediments may be ubiquitous beneath much of the valley floor.

The sequence of events associated with the deposition of these glaciolacustrine sediments remains unclear. Subsurface data and studies of new exposures indicate that the ice margin oscillated and readvanced southward towards the Tully Moraine and overrode previously deposited lake sediments. Kappel et al. (1996) logged a 3-m thick layer of dense clay till 51 m below the land surface from an exploratory hole along Otisco Road (Figure 3) which they interpreted to be the result of the compaction of lacustrine sediments by a readvance. Gomes and Pair (1997) noted the presence of tilted and glaciotectonically deformed glaciolacustrine units at a number of new exposures just north of the Tully Moraine and Gomes (1996) inferred from consolidation tests that the clays had been overridden. Based on these observations, it seems likely that glaciolacustrine deposition in the Tully Valley may have been punctuated by a number of ice marginal fluctuations.

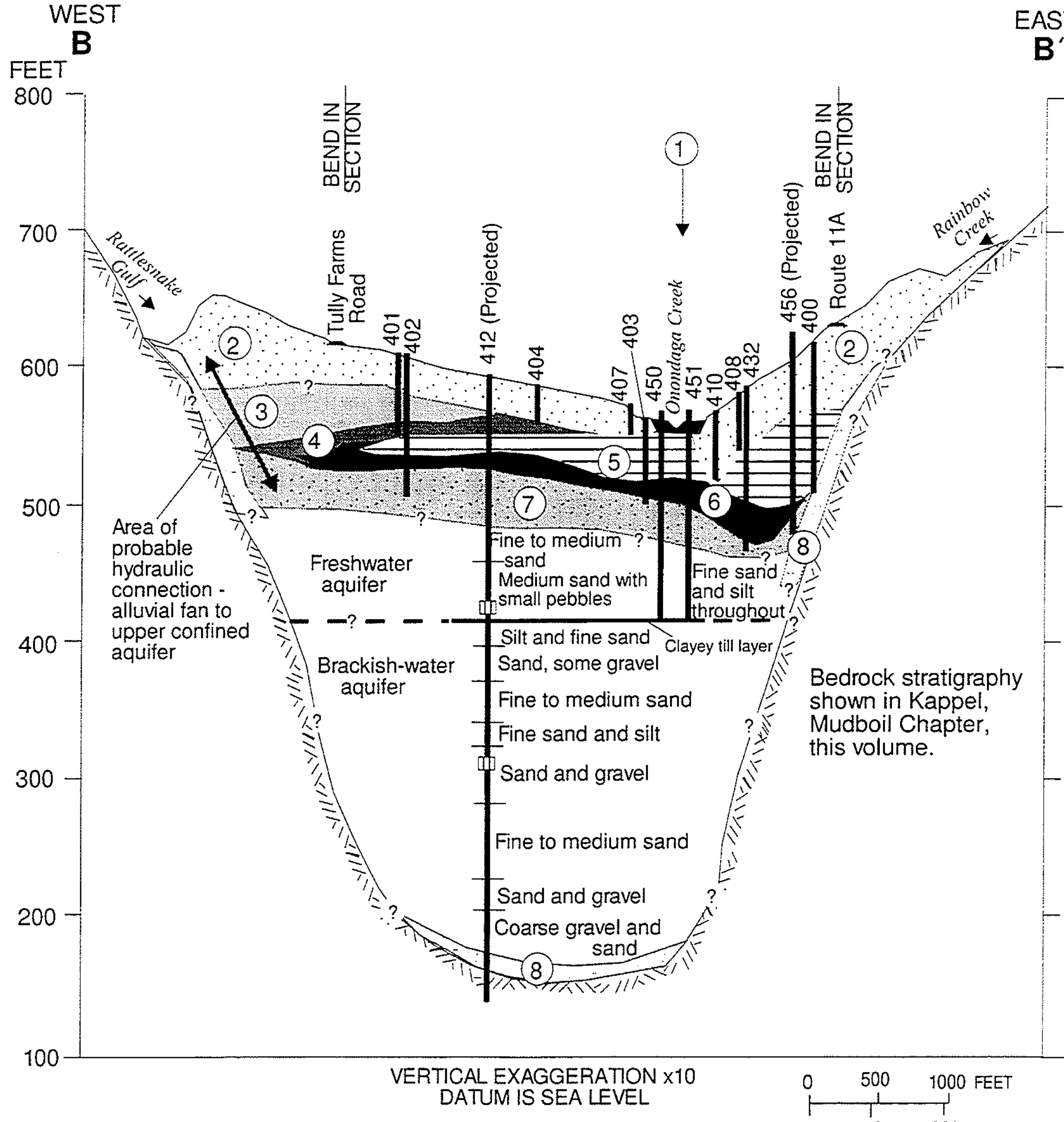
Alluvium Overlying Lacustrine Silt and Clay

This lithostratigraphic unit includes fluvial deposits, composed of poorly stratified silt, sand, and clay, underlain by laminated silt and clay (thickness 3-30 meters). It constitutes a very important surficial unit as it is found in subsurface records and in scarp exposures at the site of the 1993 landslide. This unit indicates areas where lacustrine sediments deposited in a glacial lake have been mantled by younger alluvium or are found intercalated with alluvium. The alluvium is a remnant of earlier higher fluvial surfaces initiated as the water level of proglacial lakes in the Tully Valley dropped.

Well logs and available exposures suggest that portions of the unit near valley walls may be comprised of coalescing alluvial fans formed during periods of high discharge following deglaciation. It should also be noted that the same glacial-postglacial processes responsible for the deposition of this unit also existed in other nearby valleys and that these materials may be present at the base of other slopes in the region.

Fluvial Silt, Sand, and Gravel

A unit 20-60 meters thick of coarse to fine silt, sand, gravel, and cobbles represent a complex of outwash, outwash delta, and fluvio-deltaic sediments. These materials are found at the north end of the valley near Syracuse and were deposited during deglaciation and concomitant ice-marginal drainage from the Cedarvale Channel (Figure 1) to the west into proglacial lakes occupying the Tully Valley. The elevation of the upper surface of these deposits is graded to the



EXPLANATION

ALLUVIAL DEPOSITS

(1) FLOODPLAIN AND MUDBOIL DEPOSITS - Silt, sand and gravel deposited by Onondaga Creek and upstream mudboils.

(2) FANS - Sand and gravel deposited by Rattlesnake Gulf and Rainbow Creek.

LACUSTRINE DEPOSITS

(3) LAMINATED SAND AND SOME SILT/CLAY - Mostly fine to medium sand interbedded with minor amounts of silt and clay deposited by Rattlesnake Gulf as it flowed into a proglacial lake.

(4) LAMINATED SAND AND SILTY CLAY - Approximately equal parts of very fine sand interbedded with silty-clay that settled-out farther in the proglacial lake.

(5) LAMINATED SILTY CLAY WITH SAND - Mostly silty clay inter-bedded with occasional layers of medium-to-fine sand that settled out farthest in the proglacial lake. Coarser sand is found along Otisco Road; finer sand-to-silt wisps are found farther north and south of Otisco Road. Forms the top of confining unit over the liquifiable sand and silt unit in the mudboil areas.

LACUSTRINE DEPOSITS (cont'd)

(6) CLAY AND SILT - Massive unit that generally covers most of the valley floor north and south of mudboil areas. Forms confining unit over upper aquifer and grades from clay at surface to silt at depth.

(7) SILT AND SAND - Massive, grading from silt and very fine sand at the top to medium to coarse sand and fine gravel with silt at the bottom. Unit is under artesian pressure and forms upper confined aquifer.

OTHER GLACIAL DEPOSITS

(8) TILL - A dense unit of sand, gravel,and boulders embedded in a clay matrix. This unit may underlie entire glacial sequence in the valley.

BEDROCK

410 WELL AND NUMBER, without "On" prefix

MONITORING ZONE, steel casing perforated after hydraulic testing of deeper bedrock zones and grouting of the bedrock section of deep well On-416.

Figure 3. Geologic section B-B′ showing upper unconsolidated deposits along Otisco Road and deeper unconsolidated deposits projected from well On-412, southwest of the mudboil/depression area. (Location of section shown in fig. 2.. From Kappel and and others, 1996, Figure 6.)

water level of glacial lakes occupying the valley. The water levels of these lakes were controlled by the opening of progressively lower spillways as the ice margin retreated northward.

Holocene and Recent Deposits

Alluvium and Alluvial Fans

Floodplain deposits, composed of poorly stratified silt, sand, and clay were deposited along the banks of Onondaga Creek and associated tributaries. The distribution of these deposits on the valley floor indicate the lateral migration of the channel of Onondaga Creek. A unit of poorly sorted and stratified silt, sand, and gravel deposited as fans at the base of steep slopes has also been identified where a discernible fan landform can also be identified. Materials comprising these fans are fluvially reworked from glacial materials derived from the uplands and valley walls. Well developed fans are particularly evident along valley walls where tributaries drain the adjacent uplands. These fans may have been formed in postglacial time by high discharge during wet periods (cf. Wellner and Dwyer, 1996).

Colluvium

A mixture of unsorted fine clay to coarse boulder material deposited by mass wasting is found on the slopes of the Tully Valley in several locations. Interestingly, this unit is particularly extensive on the east slope of Bare Mountain above the 1993 and older landslide locations.

Acknowledgments

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