INTRODUCTION
Wine taste and character span a wide range of variety and price. Some vineyards in France produce wine that sells for over one thousand dollars a bottle. Several hundred meters away wine may be produced that sells for ten dollars a bottle. Such differences reflect a variety of factors including the local geological terroir. Terroir is a French term for the multitude of environmental and cultural factors that combine to make one wine distinct from another. This paper explores the role geology has to play in wine production at Sheldrake Point Vineyard and in New York State generally.

Geologic History
The landscape of the Finger Lakes Region in western New York has a complex glacial history. Prior to glaciation this area consisted of a series of southward-draining rivers. By the time the Laurentide ice sheet retreated some 14,000 years ago (Muller and Calkin, 1993) these rivers had been converted to a series of elongated lakes, some hundreds of meters deep. Sediment-laden meltwater, pressurized by over a kilometer of ice, eroded bedrock up to 133 m below sea level (Mullins and Hinchey, 1989). Glacial lobes in the Finger Lakes Region carved the individual lakes and deposited the Valley Heads Moraine, a large mound of sediment at the southern end of the Finger. This caused the drainage pattern of the area to change drastically to its current northerly direction. Large volumes of glacial material were deposited across the region as the glaciers retreated northward. Glacial till was reworked by rivers that formed large gravel- and sand-rich deltas at their mouths; fine particles were deposited as a pink proglacial clay layer in the profudal zone of the lakes (Mullins et al., 1996). As the flow of meltwater subsided, lake levels dropped and these deltas were left stranded as “hanging” deltas. Other deltas formed at the new lake margin, often prograding onto the pink clay. Evidence of these ancient deltas can be seen in the common terraced topography surrounding the lakes. The terraces form flat surfaces marking ancient lake levels and drop off steeply at the delta-front. In many cases the river that formed these deltas can be identified today. Lower lake levels have allowed these rivers to erode deeply into glacial till, in some instances eroding through to the local bedrock. Continued erosion has caused many rivers to become entrenched in deep gorges. Modern deltas of this type contain local bedrock rather than the exotic rocks found in ancient hanging deltas. Such a scenario is found at Sheldrake Point Vineyard and allows modern river processes to be compared to ancient ones.

Vineyard Background
Sheldrake Point Vineyard is located on the west side of Cayuga Lake. It encompasses 38 acres and is oriented roughly perpendicular to the lake. The winery produces a variety of both red (Pinot Noir, Cabernet Sauvignon, Gamay, Merlot) and white wines (Riesling, Chardonnay, Gewürztraminer, Pinot Gris).
The vineyard consists of a series of slopes and terraces that give it a stepped topography. The area farthest from the lake is relatively flat whereas two more proximal locations, identified as delta-front environments, are steeply sloped. Two creeks entrenched in deep gorges run on either side of the property and empty into the lake. The larger of the two, Sheldrake Creek, is responsible for the formation of Sheldrake Point, a large deltaic feature that protrudes into the lake.

The climate of the Finger Lakes region can best be described as wet and moderately cool, receiving an annual rainfall of about 35 inches. Mean temperature for March through October is 58º F and the area averages about 2500 growing degree-days per season (Sheldrake Point Vineyard Weather Station).

Vine Vigor

A map showing the vigor of each individual plant was compiled by the vineyard owners and revealed substantial variation among varieties. Of more interest, however, were several plots that showed variation within a single variety. The most striking example is the Riesling (clone 2) plot (Figs. 1 and 2). Vegetative vigor is undesirable since it makes pruning difficult and has been shown to delay fruit ripening (Clingeleffer and Sommer, 1995). Previous studies have also shown that excessive vigor results from unlimited water availability (Bramley et al., 2000). In order to investigate the subsurface features resulting in excessive vigor, soil pits were dug in both high and low vigor areas. Substantial differences were found even though the pits were only 130 m apart.

SOIL DESCRIPTION

Soil at Sheldrake Point is extremely heterogeneous but in general consists of a gravelly sandy loam at the surface, gravels and sands with varying amounts of clay, and beds of pink proglacial lake clay. Most of the vineyard has calcareous thick soils, excepting parts of the northern edge of the vineyard that are as shallow as 60 cm. Lithic fragments are found throughout much of the soil column and consist of calcareous shale, sandstone, and limestone that are derived from local bedrock less than 160 km to the north. Other more exotic fragments, such as crystalline basement rocks, are also present and are likely farther traveled. On the inferred delta-front pink clay sediment is underlain by sand, suggesting ancient fluctuations in lake level.
Clay Types

Two different clay types were found at Sheldrake Point Vineyard. Proglacial pink clay exists in discrete beds and causes drainage problems in many areas. Other clay exists diffusely throughout the soil column and causes soils to become extremely hard packed when dry and may limit nutrient availability by sequestering cations. The source of this clay in Sheldrake Point soils remains to be determined. It is possible some of this clay was deposited along with deltaic deposits. Several observations, however, suggest at least partial in situ formation. The local bedrock encountered was observed to be extremely friable and largely weathered to clay products. It was also noticed on several occasions that intermediate thickness gray clay beds formed over pink clay horizons, suggesting increased rates of clay formation within perched water tables. Finally, as previously noted, clay formation appears to have occurred in modern deltas formed after lakes reached their current levels roughly 12,000 years ago (Mullins et al., 1996).

CONCLUSIONS

Sheldrake Point Vineyard is located on a series of hanging deltas. The sandy to gravelly sediment of such an environment
appears amenable to quality wine production by allowing control of moisture availability during veraison (fruit ripening). The delta-fronts, easily observed as a sharp lake-ward dip in topography, contain a shallow layer of proglacial lake clay that causes poor drainage and leads to uncontrolled vegetative growth in these areas. Those clay layers have been found in other areas of the vineyard as well due to interfingering of soil layers resulting from lake level fluctuations.

Some plants in this vineyard grow far better than others. Much of this can be explained through the genetic diversity of the different varieties. Within each variety, however, certain areas grow more vigorously than others. The best example of this exists in the southwest corner of the vineyard where a single patch of Riesling has one area that grows quite vigorously and another that is quite stunted. The high-vigor plants are underlain by a layer of pink proglacial clay that results in poor drainage. The resulting moist soils encourage vigorous vegetative growth. This condition is undesirable for grape production as excessively vigorous plants are characterized by delayed maturity.

The presence of two different clay types greatly affects viticulture in the Finger Lakes Region. Pink clay beds, deposited in ancient glacial lakes, cause poor drainage and excessive moisture availability. Diffuse darker clays, largely developed in situ, cause vine stunting by suppressing root growth and limiting nutrient availability.

REFERENCES CITED


