SURFICIAL GEOLOGY OF THE SHAFTSBURY, VERMONT REGION

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INTRODUCTION: In the Late Wisconsinan, the Vermont Valley sublobe of the Laurentide ice sheet advanced as far south as Long Island, New York, by 22,000 years BP (Sirkan, 1985) and began its retreat through the Vermont Valley roughly 14,000 years BP (DeSimone and LaFleur,1986).

The Vermont Valley is a distinct physiographic province in southern Vermont in the Bennington and Arlington seven and one half minute quadrangles. Our study area lies within the valley, bounded by the Green Mountains on the east and the Taconic Mountains on the west. Granitic gneiss underlies the Green Mountains; shales and slate underlie the Taconics; carbonate rocks, mostly dolostone interbedded with quartz, underlie the Vermont Valley. The comparative weakness of the dolostone bedrock accounts for the valley's location between the two more resistant lithologies.

The Arlington Moraine forms the northern limit of field study and the Hale Mountain Moraine forms the southern limit. These boundaries encompass an area of roughly twenty-five square kilometers. Elevation in the study area ranges from a high of 512 meters above sea level to a low of 123.2 meters above sea level.

Shilts (1966) and Behling (1966) previously mapped the Vermont Valley, and their work was incorporated into the synthesis of Stewart and MacClintock (1969). Shilts documented the presence of a glacial lake between the Arlington and Hale Mountain Moraines and named it Glacial Lake Flat Top.

GOALS: 1) To create a 1:12,000 map of the surficial deposits between the Arlington and Hale Mountain Moraines.
2) To employ the map to examine the glacial history of this area, and especially to identify the boundaries of Glacial Lake Flat Top.
3) To use the information taken from our examination to create a morphosequence map portraying the chronology of deglaciation of the area.

METHODS: Since our study area is relatively small, we explored it by vehicle and on foot. We spent a period of two weeks thoroughly covering the area, mapping contacts and determining the nature of surficial deposits. We focused upon twenty-four significant sites, supplemented by areas of less-concentrated study. Site examination consisted of a detailed comparison of landforms and sedimentological characteristics such as bedding, texture, sorting, clast lithology, and clast to matrix ratio.

Stereoscopic aerial photographic interpretation proved to be a valuable tool in mapping contacts inaccessible by foot or vehicle. Fortunately, this was a relatively small portion of the area. Through aerial photographic analysis, we also evaluated landscape morphology in an effort to clarify contacts observed in the field.

We incorporated information from well logs, reviewed by Jerris (1991), to determine depth to bedrock. From this evaluation, we gained a better understanding of the role of structural geology in the development of the area's modern morphology. Interpretation of well log data allowed us to infer the nature and extent of Pleistocene glacial deposits underlying the more modern Holocene sediments.

With these data, we created a map of the the surficial deposits between the two moraines (Figure 1), and from that map developed a morphosequence map illustrating the history of deglaciation between the Arlington and Hale Mountain Moraines (Figure 2).

CHRONOLOGY OF DEGLACIATION: Our morphosequence map indicates that the glacier retreated through the Vermont Valley in three stages. During the first stage, the lobe of ice paused at the present location of the Hale Mountain Moraine. It remained there long enough to deposit a thick till moraine, with associated ice-contact stratified drift. The western margin of the sublobe became a region of significant ice contact deposition. As the glacier stagnated, massive kame terraces were constructed along the upper valley wall, and the southernmost tip of the Hale Mountain Moraine experienced a large-scale influx of sediment contemporaneous with the development of an esker complex deposited beneath the ice. Recent work south of our field study shows that the pause of the ice margin prevailed through several stages in the draining of Glacial Lake Bascom (Small and DeSimone, 1993).

During the second stage of deglaciation, the Vermont Valley sublobe renewed its retreat. Differential melting left blocks of ice behind, allowing for deposition of ice contact stratified drift (kamic material). The landscape, as defined by the ice at this time, may have given the appearance of "Swiss cheese", with drift accumulating in the voids between the rotting blocks of ice. In the northwestern region of our field study, the tips of kame terraces formed along the upper parts of the valley wall protrude into lowland areas. This topography provides evidence that the glacier was pulling away from the valley walls and depositing less sediment as it thinned. Eskers continued active formation under the retreating terminus; therefore, the esker complex represents time-transgressive deposition. The changing texture of sediment within the esker complex as one proceeds north supports this hypothesis. Final melting of ice blocks draped ablation till over sections of the valley.

The third stage of deglaciation represents the interval during which the glacier actively constructed the Arlington Moraine. Stagnant blocks of ice remained in the valley south of the terminus, continuing deposition and formation of ice contact landforms. The younger moraine differs from the Hale Mountain Moraine in that it is predominantly composed of kamic material, characterized by hummocky terrain. Eskers formed behind the moraine, feeding it tremendous amounts of sediment ranging in size from fine sand and silt to large boulders.

The landforms constructed in the previous two time periods created a natural basin which trapped the meltwaters of the glacier. We hypothesize that the Hale Mountain Moraine functioned as the dam of these waters, forming Glacial Lake Flat Top. The lake was bounded on the west by the valley wall and on the east by the valley wall and stagnant ice. At the north end of the lake, the meltwater within the esker tunnels emptied into the lake and constructed a delta rising to an elevation of at least 332 meters above sea level. Extensive areas of lake sediment composed of fine sand and silt accumulated over the open water areas of the bottom of Glacial Lake Flat Top, south of the delta. Elsewhere in the lake basin, no sediment accumulated and area of bare rock are exposed, indicating the presence of grounded ice blocks within the lake.

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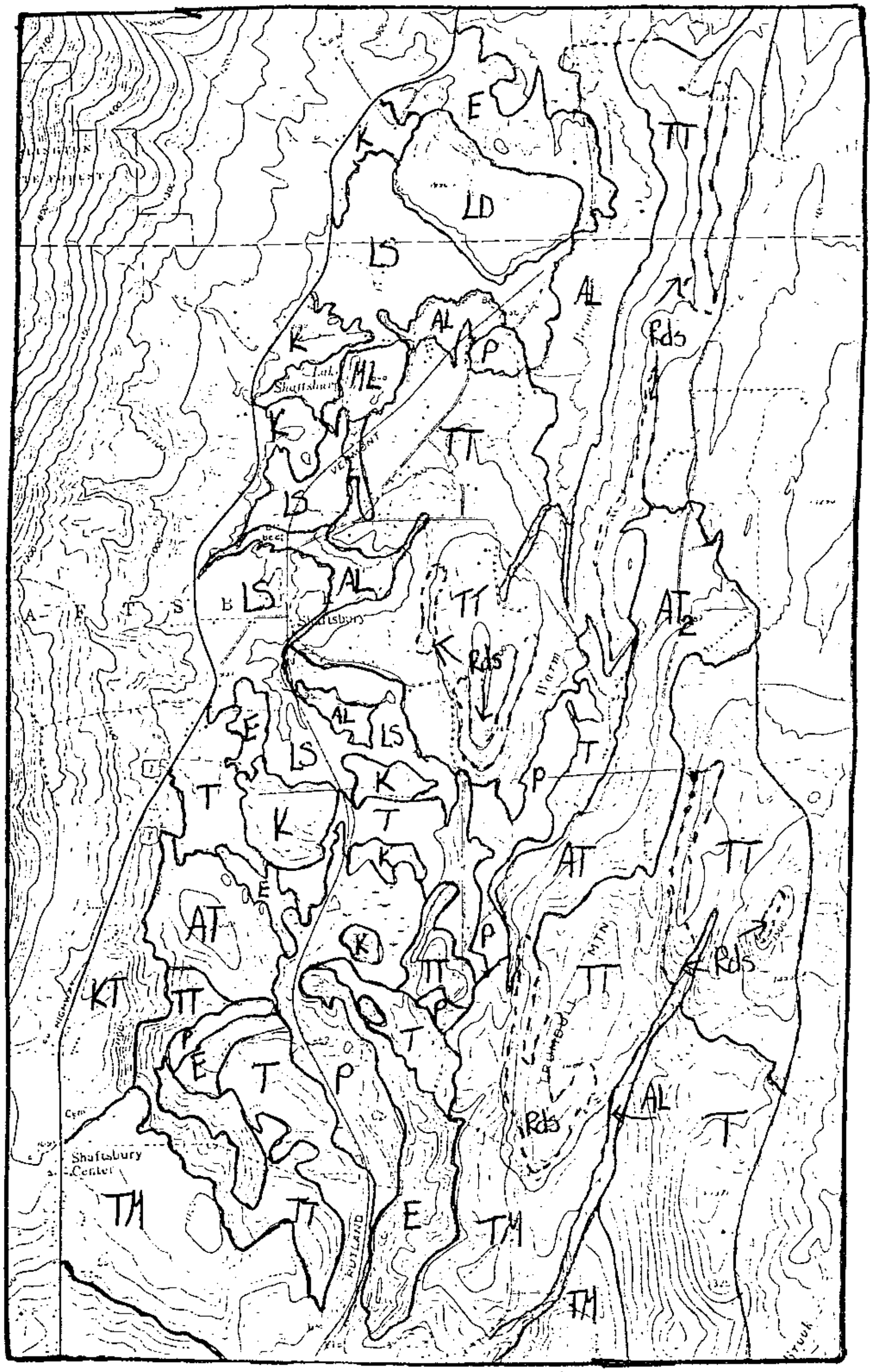

KEY

AT Ablation Till
AL Alluvium
E Esker
K Kamic
KT Kame Terrace
LD Lake Delta
LS Lake Sediments
ML Modern Lake
P Paludal
Rds Dolostone Bedrock
T Thick Till
TT Thin Till
TM Till Moraine

FIGURE 1: Map of surficial deposits between Arlington and Hale Mountain moraines.

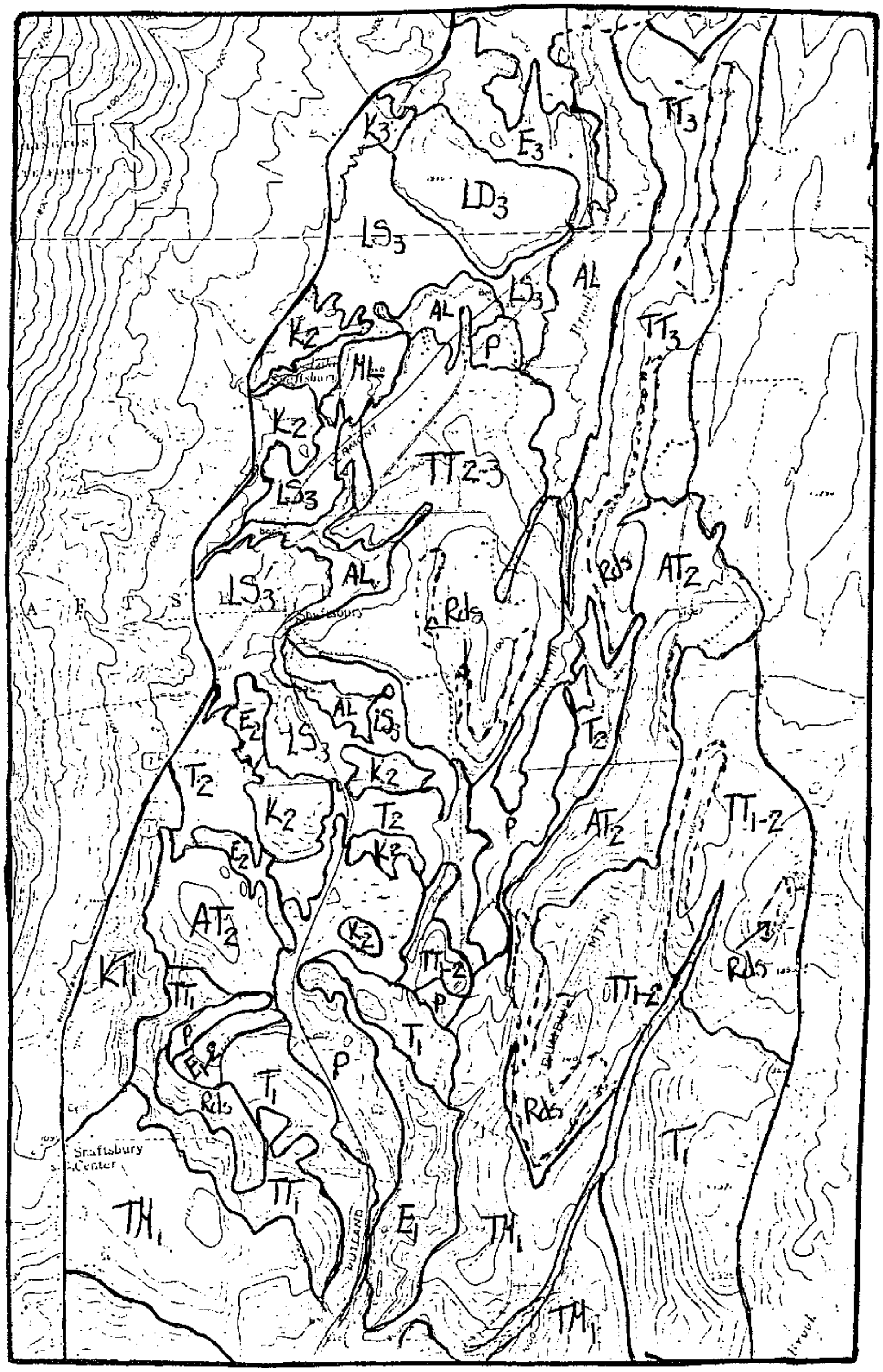

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FIGURE 2: Morphosequence map illustrating the chronology of deglaciation in the study area. Subscripts next to deposit labels indicate in which stage of deglaciation the deposit was formed. Modern sediments (alluvium, paludal, etc.) have no subscripts.