DEFLECTION OF ICE FLOW BY A BEDROCK RIDGE

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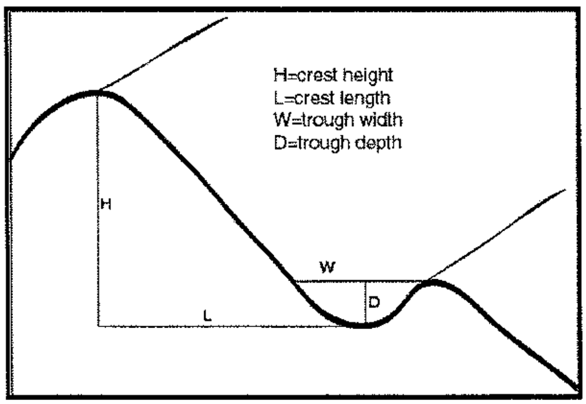
INTRODUCTION

The western edge of the Mendenhall Glacier of the Juneau Icefield, Alaska terminates at a bedrock ridge or "rib" of schist. As recently as ten years ago, the ice covered much of this rib, providing for extremely fresh and plentiful striations. This ridge consists of a series of stoss and lee features stair-stepping up to the crest. Air photos and field observations reveal that the rib deflects glacier flow to a certain degree to follow the strike of the forms. The purpose of this study is to determine the influence of the entire rib (macroscale) and different aspects of individual stoss and lee features on the rib (microscale) in deflecting glacier flow.

METHODS

The ridge was divided into two regions, one to the southeast, closer to the lake, and the other to the northwest. In the southeastern region, data were collected along two long transects. The northwestern region was divided into individual stoss and lee features. Data were gathered along two to four transects for each of these features. For each of these transects, striation trends were recorded noting the position along the transect line. When possible, five striations were taken at each location, then averaged to obtain the overall trend for the location. Joint plane density, strike and dip were also taken down using this method. The slope of each face, the location and approximate strike of each crest and trough were recorded along with orientation of transect line and relative elevations. These data were used to calculate specific characteristics of each stoss and lee feature (Figure 1). The objective of this was to record the variations in striation direction and rock jointing and the relationship to the underlying morphology.

Figure 1: Features calculated from field data



These characteristics were later analyzed with simple regression versus the change in trend from the lowermost striation on a given form to the uppermost (top/bottom) and versus the maximum change (max) in striation trend (oftentimes the greatest difference was between the lowermost striation and the second to the uppermost striation). Then, using the computer program *S-Plus*, these factors were analyzed with multiple regression to determine the relative importance of each characteristic in the presence of the others. Rose diagrams were used to analyze the large-scale changes from top to bottom of each region and from region to region.

RESULTS AND DISCUSSION

Entire Ridge (Macroscale)

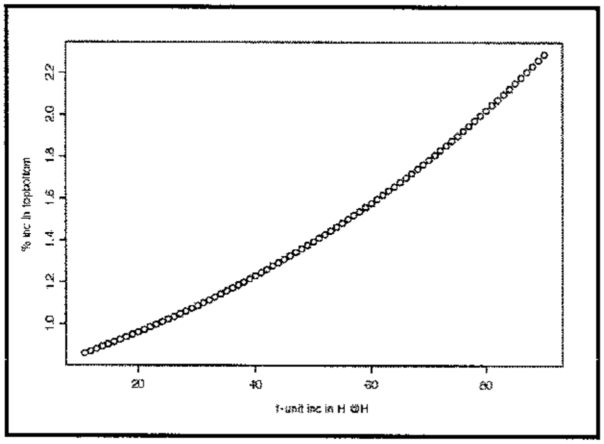
Average striations taken at each location were put into four groups: one for the half of stoss and lee features closest to the ice in the northwest region, a similar one for the southeast, one for the half of features furthest from the ice in the northwest region, and one for the same half in the southeast. Within each region, no significant change was noted from the proximal half to the distal half. However, there was and compares top/bottom to all of the characteristics (Table 2 and Figures 5 and 6). These data points are missing only one measurement and the estimates are from memory and similarly proportioned features. With these extra data, the model is much more complex, involving polynomial expressions as well as natural logs. The R^2 is .72, slightly lower, but still of good predictive value. Although some data is estimated, the larger number of points makes this as valuable a model as the previous one.

The third model again uses only data collected in the field, but this time compares the maximum change in striation trend (max) to the various characteristics (Table 3). This regression has an R^2 of .74, again, not as good as the first model, but still a good predictor. This also has the advantage over the first model in that it does not eliminate any points and hence has more data from which to create the model. The fourth and final model is another fairly complex model, excluding one point which, when included, has an extremely large effect on the model (Table 4 and Figure 7). For this regression analysis, max is compared to the characteristics using the same data as the second model. The R^2 here is .72 and thus still maintains a good predictive value. Models of these types including H/L and W/D are also performed, but have less predictive value than the four presented here.

Characteristic	%Increase in Top/Bottom per 1 meter increase
H	-12.75
L	18.54
W	8.78
D	-28.84

Table 1: Top/bottom (see text for explanation) model 1

Figure 5: Change in top/bottom (see text) vs change in H (crest height)



Characteristic	% Increase in Top/Bottom for increase
H	See Figure 5
L	See Figure 6
W	6.37 per 1 meter increase
D	-.63 per 1% increase

Table 2: Top/Bottom (see text for explanation) model 2

Figure 6: Change in top/bottom (see text) vs change in L (crest length)

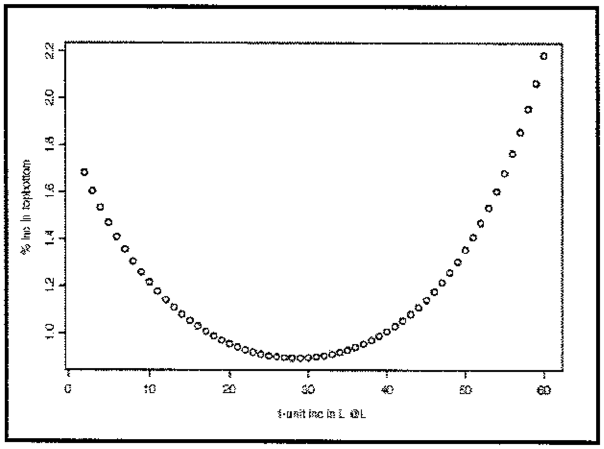


Figure 7: Change in max vs change in H (crest height)