Using Soil Surveys to Delineate Quaternary Parent Materials and Landforms across the Des Moines Lobe of Iowa and Minnesota

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Objective

We developed a highly detailed Quaternary geology map of the Des Moines Lobe, using readily available National Cooperative Soil Survey (NCSS)data. We then compared that map to Quaternary geology maps previously published by geologists for agreement and potential advantages for understanding subtle landform characteristics.

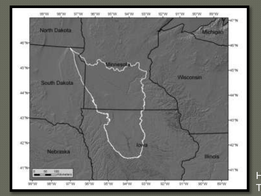
Introduction

We selected the Des Moines Lobe for this study because NCSS mapping across it heavily relies on the Quaternary landscape model developed by Ruhe (1969). In other words, we hypothesized that NCSS data and Quaternary maps are nearly one and the same on the Des Moines Lobe. Hence, one of the best tests for the utility of the NCSS data would be this comparison. We hypothesized that the resulting Quaternary map would be an improvement over existing surficial geologic maps because the NCSS puts considerably more resources into county soil surveys than found in most classical geologic maps.

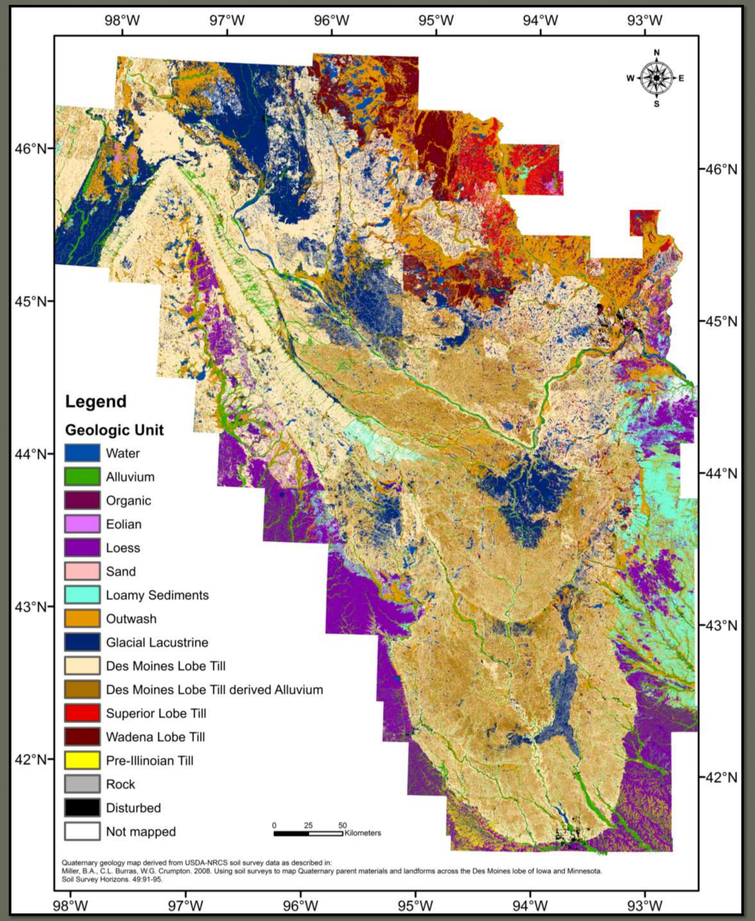
Methods

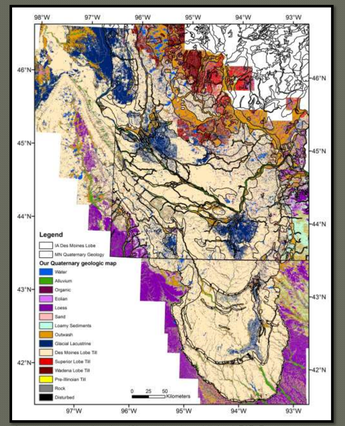
Digital county soil maps were obtained from the USDA-NRCS Soil Survey Geographic (SSURGO) database. We constructed a database that categorized each soil series that appeared in the selected counties for surface geologic attributes. The database key was based on terms found in the online Official Series Descriptions. Since soil surveys, official series descriptions, and geological nomenclature continue to evolve, some interpretation was necessary in labeling soil map units in geologic unit terms. We then linked our database to the SSURGO shapefile in ESRI's ArcGIS 9.3 software.

In order to view the entire lobe, it was necessary to group some of the soils information into 16 geologic units, based mainly on perceived soil parent materials, e.g. outwash, loess, rock, etc. More detailed information, such as the type of rock for outcrops, is included with the soil survey description and maintained in the category codes created for this study. Some soil descriptions included buried parent materials, but for this study, the map was simplified by only displaying the surface parent material.

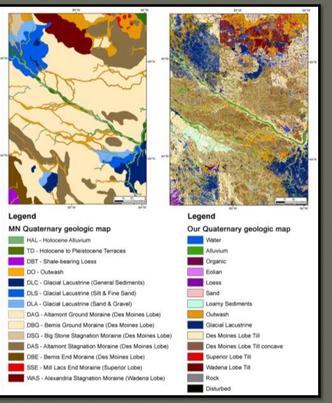


Hillshade map of the study region. The Des Moines Lobe is highlighted.



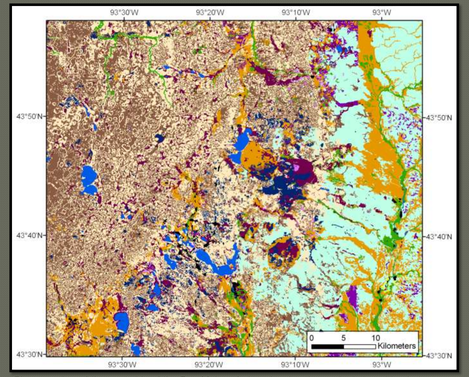


An overlay map showing (1) previously published GIS Quaternary geologic maps (Minnesota Geological Survey and Iowa Geological Survey) on top of (2) our Quaternary geologic map derived from soils data.

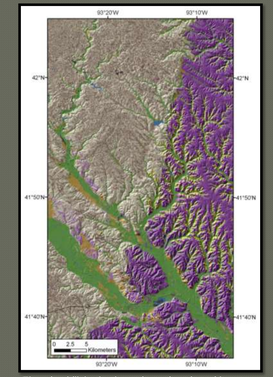


Side-by-side comparison of (left) the Minnesota Quaternary geologic map and (right) our Quaternary geologic map.

Examples of Detail



Close-up view of the east side of the Des Moines Lobe, showing the geologic transition between Des Moines Lobe and Iowan Erosion Surface.



Elevation hillshade shown in conjunction with our Quaternary geologic map. Note that by adding the hillshade, the display of relief compliments the geologic map at this scale.

Conclusions

Categorization of soil map units with respect to geologic unit, particularly soil parent materials, resulted in a detailed Quaternary geologic map for the Des Moines Lobe. This map agrees well with the existing Quaternary geologic maps while adding a user-controlled level of scale and detail.

Our work highlights both similarities and differences in the two map types, as would be expected, given the different mapping mandates that drive each mapping effort. Increased dialog between the two disciplines (soils and geology), and additional ground-truthing, may help resolve these differences and provide answers to questions that have remained for both groups. For example, the level of detail surveyed by soil scientists could help geologists decipher ambiguous or complicated areas of multiple glacial advances.

After the development of keys that relate soil survey terminology to information of geologic interest, we believe that soil survey data provide quick and easy reference data for geologic inquiry. The same concept applies to any discipline affected by soil properties. Within the soil survey, soil series are expected to consistently describe a defined range of soil properties. Those definitions should be used to create a spatially linked database for the attributes of interest. In the future, other soil properties could be added and studied spatially at practically any scale.

Legend for detail example maps shown above.