Using Soil Maps as a Tool to Improve Geologic Maps

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Introduction

- Geology and soil science have a long joint history
- Geologists were involved in much of the early soil mapping efforts
- These early maps were largely surficial geology maps
- As soil science and soil mapping advanced, concepts of soil become more complex
- Multiple factors of soil formation were recognized, leading to more complex classification systems that supported soil mapping
- However, many of these classification systems still include aspects such as geology (parent material) and topography
- Much soil mapping has also been done using soil landscape relationships
- This maintains a level of geologic information within soil maps, and the possibility of being able to extract geologic information from soil maps

Examples of Soil Maps Used to Improve Geology Maps

- The use of soil information to improve geology maps goes back to at least the late 1940s
- Thorp (1949) used loess-derived soils to expand recognition of loess deposits on geologic maps of the Midwestern USA
- Rogers (1953) used soil maps to fill in gaps between existing geology maps in eastern Tennessee, USA
- Lindholm made geologic maps of the Culpeper Basin, Virginia, USA in the 1970s using soil maps to facilitate his research since geology maps for the area did not exist (Lindholm, 1993) (Figure 1)
- Brevik and Fenton (1999) used soil maps to expand on geomorphological mapping of the Lake Agassiz strandlines in eastern North Dakota, USA (Figure 2)
- Schaetzl's research group has used soil maps to investigate loess thickness and distribution in Wisconsin and Michigan, USA (Figure 3)

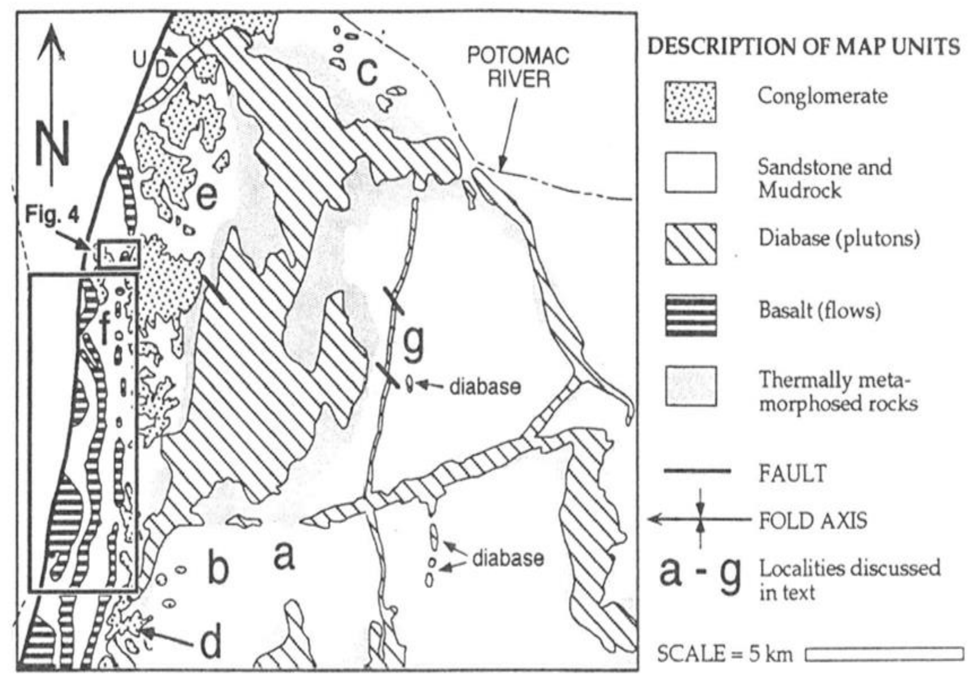


Figure 1. Geologic map of part of the Culpeper basin compiled by Lindholm (1993) from soil survey maps.

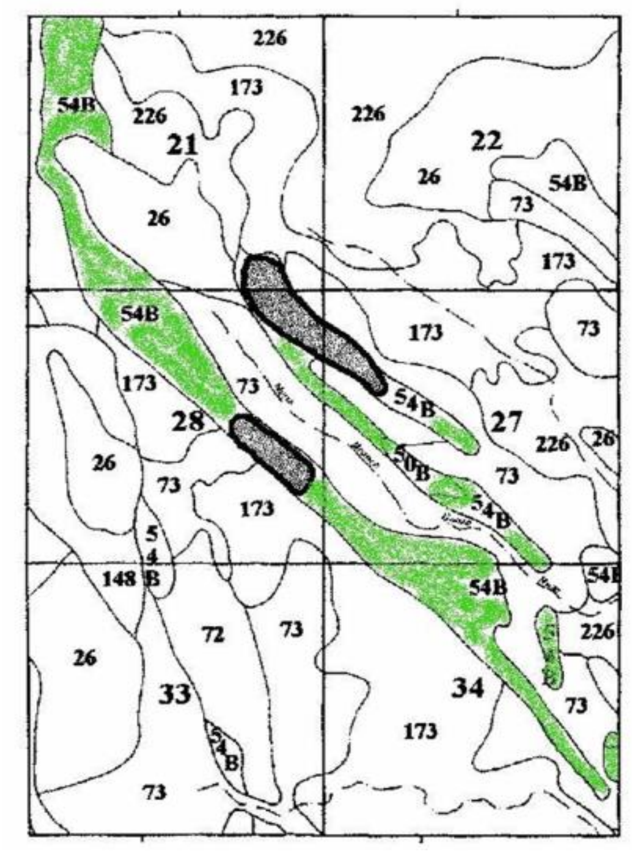


Figure 2. Areas shaded gray were mapped as strandline by geologists. Areas shaded green show soil map units that indicate potential extensions of strandlines. Modified from Brevik and Fenton (1999).

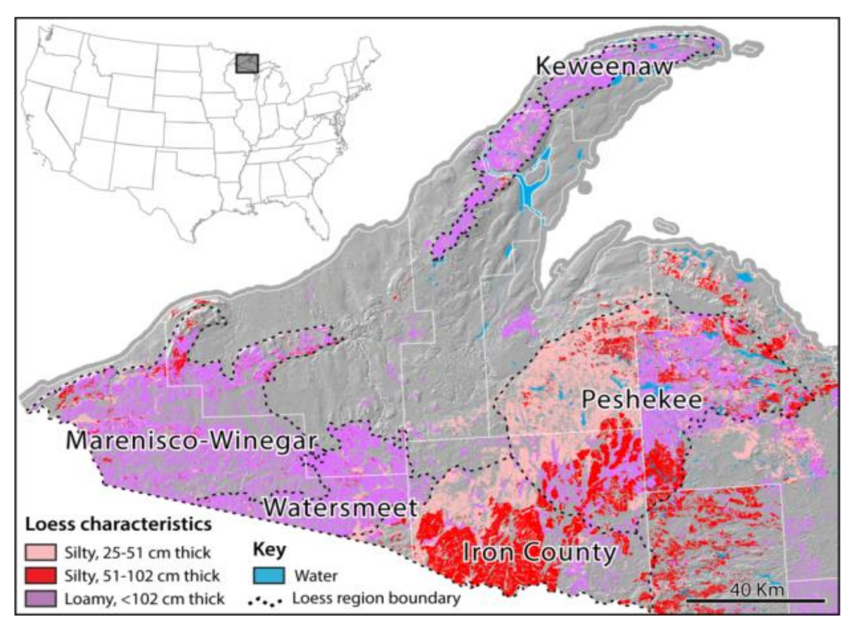
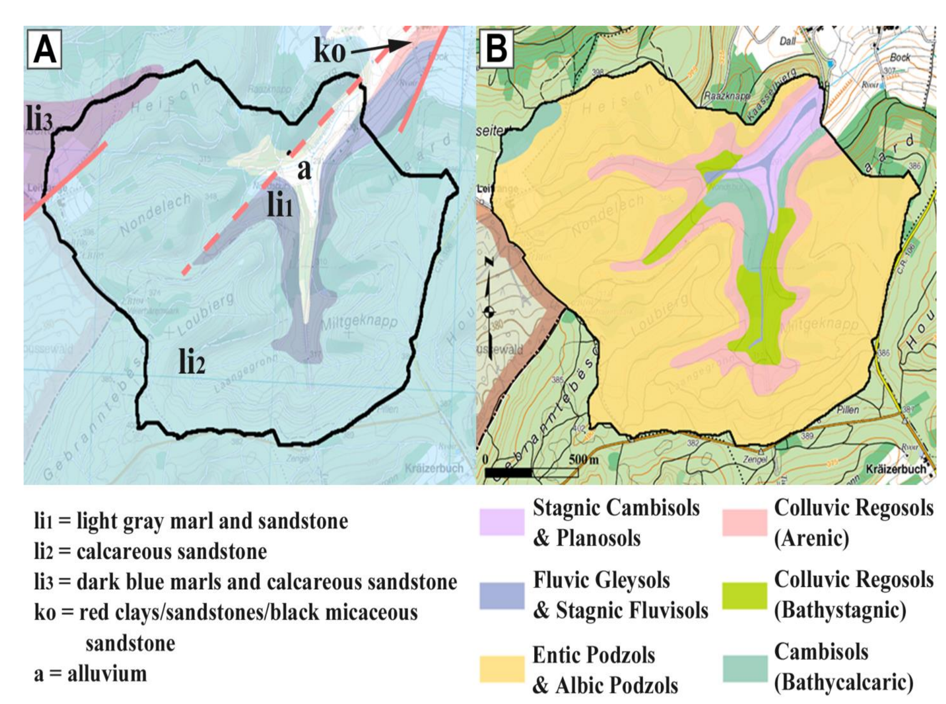


Figure 3. Loess regions within the Upper Peninsula of Michigan based on soil maps (Scull and Schaetzl, 2011; Luehmann et al., 2013).

Figure 4. Side by side display of the (A) original geology map at 1:25,000 and (B) the soil map produced by Juilleret et al. (2012). In this area, Cambisols were found to correspond to the geologic map units li3 and li1, Podzols with li2, Planosols and Stagnic Cambisols with ko.



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Examples of Soil Maps Used to Improve Geology Maps (continued)

- In Luxembourg, Juilleret et al. (2012) created a soil map and compared it to the existing traditional geology map (Figure 4)
- Oehlke and Dolliver (2011) and Miller and Burras (2015) found agreement between soil-based geology maps and traditional geology maps ranging from 56 to 99%, depending on the matching of time frames for map production

Discussion

- There are strengths and weaknesses to using soil maps to aid in geologic mapping
- In all cases researchers determined soil maps aided in determining geology
- When soil maps are made with higher resolution than geology maps, that higher resolution can support the needs of environmental or engineering studies
- However, soil maps are not mapping geology, even though the two are related
- A soil map can only capture geologic information that is also relevant to the relatively shallow soil being mapped
- On the other hand, soil maps can emphasize surficial geology overlooked by geologists focused on deeper units
- Differentiating unit ages is a priority for geologists, but generally not for soil scientists
- Integration of maps can point out areas that need additional work to both fields

Future Needs

- Due to the higher availability of detailed soil maps in glaciated landscapes and temperate climates, the publications found using this approach tended to be from those areas
- Although research testing this approach with existing detailed soil maps in other regions would be valuable, it may be a more efficient strategy to work on map improvements as joint endeavors between the disciplines