Pedogenesis in Reclaimed Lands Compared to Natural Pedogenesis

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Introduction

- Since the Surface Mine Control and Reclamation Act was passed in 1977 it has been required that disturbed lands be returned to their original condition.
- Several soil amendments have been used to enhance reclamation efforts.
- Many ways to evaluate the effectiveness of soil reclamation (organic C and/or N accumulation, reduction in bulk density, formation of soil structure, nutrient availability, soil biological activity, etc.) have been evaluated.
- For a pedologist, the ultimate measure of reclamation would be to re-establish the original soil profile.
- This presentation evaluates rates of soil formation in reclaimed land and compares it to natural rates of pedogenesis.

Materials and Methods

- Studies that reported depth of pedogenesis over approximately 30 years were gathered from the literature.
- Depth of pedogenesis was used rather than other measures (e.g., profile development indices, degree of horizonation) because both natural pedogenic and reclaimed studies reported it.
- Logarithmic regression trend lines were fitted to the data because pedogenic rates typically decline with time.
- Relationships between regression lines were tested by comparing the slopes of the regression lines and the elevations of the y intercepts of the regression lines and testing the hypothesis that the two regression line slopes/elevations were the same.

For More Information

- For more information on this study, including the literature reviewed and details on the statistics, obtain a copy of Brevik and Lazari (2014) from the Soil Horizons website (https://www.soils.org/publications/sh) or contact Eric Brevik at Eric.Brevik@dickinsonstate.edu for a pdf copy.

Reference

Brevik, Eric C., and Andreas G. Lazari. 2014. Rates of Pedogenesis in Reclaimed Lands as Compared to Rates of Natural Pedogenesis. Soil Horizons 55: doi:10.2136/sh13-06-0017.

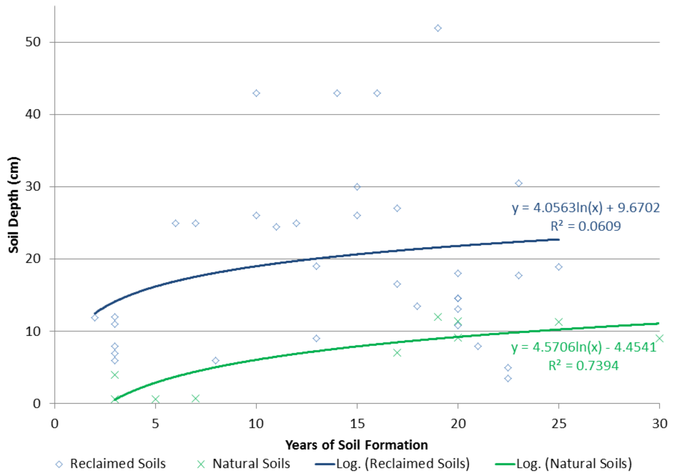

Figure 1. Plots, logarithmic regression trend lines, regression equations, and R^2 values for reclaimed and natural soil pedogenesis.

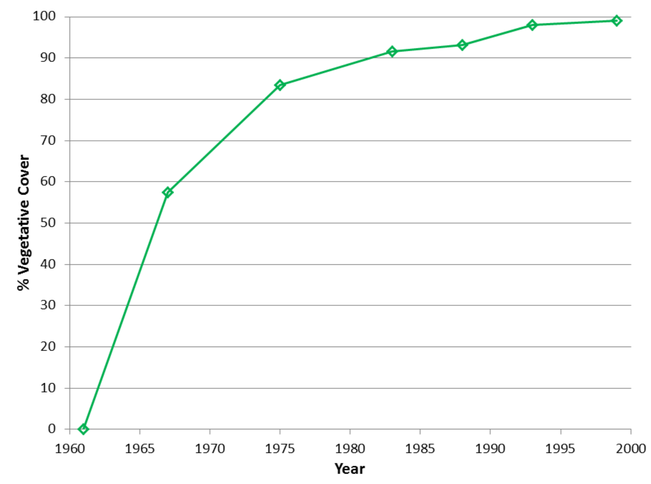

Figure 2. The revegetative history of a borrow pit, about 5 ha in area, in southern Georgia, USA, that was allowed to revegetate naturally following excavation.

Figure 3. It can take considerable time for disturbed land to revegetate naturally. Left – sand borrow pit in Georgia, USA after 40 years, Right – Undisturbed areas around the same borrow pit.

Results and Discussion

- Statistical analysis failed to reject the null hypothesis that the slopes of the two regression lines were equal ($p = 0.65$), but the null hypothesis that the elevations of the two regression lines were equal was rejected ($p = 0.002$).
- This indicates that pedogenesis is happening at the same rate in both the natural and reclaimed soils; however, total pedogenesis is not the same over the same duration of pedogenesis in the two systems.
- Soils in the reclaimed studies show more pedogenic progress after a given time of pedogenesis than soils in the natural studies.
- The natural pedogenesis studies gave a regression equation with a slope of 4.57, a y intercept of −4.45, and an R^2 value of 0.74 (Figure 1).
- The reclaimed pedogenesis studies gave a regression equation with a slope of 4.06, a y intercept of 9.67, and an R2 value of 0.06 (Figure 1).
- The same slope with higher elevation indicates the reclaimed soils are not undergoing pedogenesis any more rapidly than the natural soils.
- However, the reclaimed soils started at a more advanced stage of pedogenesis than the natural soils, likely due to the many amendments often used during reclamation efforts.
- As an example, reclaimed areas are typically revegetated rapidly, while natural disturbed areas may take many decades to revegetate (Figures 2, 3). Vegetation, in turn, is important in pedogenesis

Conclusions

- A review of the literature on pedogenesis indicates that reclamation techniques do not increase the rate of pedogenesis in reclaimed soils when compared to natural pedogenesis.
- However, reclamation efforts do have the ability to start the pedogenic process at an advanced stage with parent materials that are well covered with vegetation and conditions that are enhanced to support vegetative growth and build the soil ecosystem.