SOIL CHRONOSEQUENCE STUDY OF LONG VALLEY, NORTHERN NEW MEXICO: INSIGHTS INTO THE DEVELOPMENT OF SOILS ON CATENAS IN A POST-GLACIAL VALLEY

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The history of glacial advance and retreat cycles in mountain watersheds is recorded in a variety of landforms including moraines, lake sediments, and outwash deposits. The Sangre De Cristo mountain range in northern New Mexico contains some of the southernmost glacial activity in North America; yet there have been few studies to determine how these advances correlate with the mountain glaciations of the Rocky Mountains. In this study, we combine field geomorphic reconnaissance, terrain analysis, and soil development indices to determine the relative size and extent of glacial advances in Long Valley, a formerly glaciated valley in the Sangre de Cristo Mountains. The relative ages of Pleistocene and Holocene glacial deposits were investigated through a soil chronosequence established across several moraines in Long Valley extending east from Big Costilla Peak to the Costilla Vega playa. A soil profile development index (SPDI) utilizing several soil development parameters was used to identify differences in soil development between the different moraines. Utilizing the calculated SPDI values as well as field and DEM observations of moraine morphology, four glacial cycles are observed within the Long Valley moraine sequence. These cycles were correlated with the glacial/paleoclimate history of the southern Rocky Mountains. One Bull Lake advance, two Pinedale advances, a pre altithermal Latest Pleistocene / Early Holocene glaciation, and two small post-altithermal Neoglacial advances were identified. Several studies have suggested that soils developed on moraine summit are often eroded and cannot be utilized to separate glacial advances of significantly different ages. Soils developed along moraine catenas were described in this study. Summit soils exhibited the greatest correlation with age compared to toeslope and backslope soil profiles.

While the SDI based on soil morphological parameters clearly separated different aged deposits, several pedogenic chemical alterations were also investigated. Soil clay content increased uniformly with age across all catenary positions as well as increasing downslope. Hydroxalamine extractable poorly ordered iron decreased with age while Dithionite extractable secondary iron oxyhydroxides increased with age. The ratio of poorly ordered to secondary iron oxyhydroxides decreased with time. Organic carbon content could distinguish between moraines within the cirque and valley sequences but not between individual moraines.

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Glacial Ages, Soils, Chronosequence, Soil Development, New Mexico, Sangre de Cristo Mountains

pp. 28
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