A COMPARISON OF RELATIVE SOIL DATING TECHNIQUES IN A COASTAL DUNE ENVIRONMENT

Abstract

Relative dating methods utilizing soil hue, chroma, and intensity have been documented in literature since 1965 (Buntley and Westin, 1965). Other methods such as Harden's soil development index include soil structure and other features (Harden 1982, 1988). These methods rely heavily on the physiochemical processes that are manifest as color changes and/or structural changes in the soil profile. These methods also rely strongly on the concept of a soil chronosequence, in which the only variable changing between multiple soils localities is time. These indices were applied to soil profiles forming in coastal dunal soils of the Coos Bay and Florence Dune sheets on the south-central coast of Oregon. The soils are characterized by loose to medium dense, slightly silty sand to slightly clayey, silty sand comprised of quartz and feldspar dune sand with minor heavy minerals. Dunal terrain is highly variable, from steep lee slopes of the dune slipfaces (up to 44°) to interdunal flats (Hunter et al., 1983).

Between 1996 and 2000, sand beneath the soil profile (Cu or Cox) from multiple locations has been dated using thermoluminescent (TL) or, on organic material from within the soil profile, 14C dating techniques. Soil dates ranged from 0.7 +/- 0.06 to 70.2 +/- 3.0 TLYBP or RCYBP (Beckstrand, 2001). Indices based on soil color provided results inconsistent with TL or 14C dating. The two methods were not mutually supportive, nor did they correlate well with actual dates, with Harden's rubification approach providing a nearly random correlation coefficient (CC) of 0.05. The Buntley-Westin method was somewhat more reliable with a CC of 0.66. The two methods that supplied better results were simply the thickness of the profile (CC=0.71) and the relative density or stiffness of the soil as measured with a pocket penetrometer (CC=0.94). The most direct and simple measure of soil age proved the most reliable.

It is likely that the concept of a soil chronosequence could not be upheld in a dunal environment spanning at least 70,000 years. Variations in climate and vegetative cover over that time have been great (Worona and Whitlock, 1995). Other factors, such as slope angle, groundwater chemistry, and slight changes in physical attributes of the sand (such as grain size) likely play a major role in determining final soil profile characteristics.