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DISTRIBUTION OF PEDOGENIC IRON IN SOME ARID SOILS OF RAJASTHAN

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ABSTRACT

Seven soils, showing varying degrees of pedogenic manifestations occuring on old alluvial plain, dune field and peniplain landforms of the Indian arid region, were studied for the distribution of forms of pedogenic iron. Study revealed an accumulation of pedogenic iron in B horizon of all the soils but the content was high in soils showing higher degree of pedogenic manifestations. Distribution of free oxide form of Fe followed the clay profile, whereas the content of amorphous form of Fe was maximum in the surface horizon and decreased with depth. Variation in active iron ratio in these soils was due to ageing effect.

INTRODUCTION

The distribution pattern of various forms of iron in soil has been regarded as an index of soil development and also in defining diagnostic horizons and in describing pedogenic processes (Mc Keauge and Day, 1966; Blume and Schwartmann, 1969). This paper reports the distribution pattern of forms of pedogenic iron in arid soils showing varying degree of pedogenic manifestations.

MATERIAL AND METHODS

Seven pedons of identified soils, which vary in their pedogenic manifestations, were selected for the study. Soil samples from each horizon were collected and analysed for pH, organic carbon, mechanical composition and acid soluble iron by the procedure described by Piper (1950). Pedogenic free oxide (Fe-d) was extracted by citrate-bicarbonate- dithionite (Mehra and Jackson, 1960), amorphous form (Fe-o) by ammonium oxalate of ph 3.0 (Me Keauge and Day, 1966) and total (Fe-t) by $HF\text{-}HC10_4$ (Jackson, 1958) methods. Iron in all the extracts was determined by atomic absorption spectrophotometer. Sand and clay fractions from a few decalcified soils were also analysed for iron forms and were studied under polarizing and electron microscopes.

RESULTS AND DISCUSSIONS

The soils were far from uniformity in pedogenic manifestations (Table 1) and physico-chemical characteristics. pH varied between 7.8 to 8.7. The $CaCO_3$ content which ranged between 0 to 46.2 % increased with depth in all soils and highest was

Table 1 : Degree of manifestations of various pedogenic processes in soils of different landforms

Landform	Period of formation	Soil	Profile No.	Leaching of carbonates	Segregation of carbonates and formation of nodules	Pedality and structural development	Chroma development	In situ weathering and clay formation	Illuviation
(A) Medium to fine textured	Alluvial Plain Early to mid Pleistocene	Pali	P_1	Well marked	Strong	Strong	Strong	Distinct	Moderate
		Pipar	P_2	,	,,	,,	,,	,,	,,
		Gajsingpura	P_3	,,	,,	,,	,,	,,	Slight
(B) Coarse textured	Late-Pleistocene	Chirai	P_4	,,	Moderate	Weak	Weak	Very weak	Absent
Dune field	Holocene	Dune	P_5	,,	None	Nil	Negligible	Nil	Absent
		Shergarh	P_6	,,	Slight	Nil	,,	Nil	Absent
Peniplain	—	Palari-Pichkia	P_7	,,	Slight	Moderate	Strong	Weak	Slight

found in Gajsinghpura soil. Pali soil contained highest amount of clay (28 to 43 %) followed by Pipar and Gajsinghpura (17 to 27%), Chirai (4 to 11%) and dune field soils (2 to 5%). The B horizon of all the soils contained higher amount of clay than Ap and C horizons.

The distribution pattern of forms of Fe showed an increase in content with depth and was maximum in the B horizon of the profiles (Table-2). This could be due to greater weathering (Barshad, 1974) and/or illuvial accumulation (Smith and Buol,,1968). The content of Fe-d, in general, followed the clay distribution indicating an association of Fe-d with finer fraction in these soils. This could possibly be due to absorption of electro-positively charged Fe ions released during weathering under oxidising environment on the clay particles (Birkeland, 1974 and Tan, 1982). The absorbed iron subsequently aged during soil profile development which was evident by persistence of iron oxide coatings on CBD treated clays (observed under electron microscope). Data further showed a high content of Fe-d in the horizons P_1-P_3 soils (Table 2) possibly due to higher weathering and transformation of minerals (Choudhari and Dhir, 1982) and also due to illuvial accumulation of clay (Table 1).

Chirai soil (P_4 horizon), although sandy and younger in age than P_1 to P_3 showed a higher content of Fe-o in Ap and B horizons, possibly, due to slight weathering evident by somewhat stronger chroma and structural development (Table 1) in profile. Lower extractability ratio (Fe-d/Fe-t) and higher active iron ratio (Table 2) provides snpporting evidences of some release of iron not undergone ageing as in P_1 to P_3 soils.

The absolute values of Fe-o and Fe-d in dune field sandy soils (P_5 and P_6) which were devoid of pedogenic features, were comparable with P_4 and P_7 showing higher proportion of finer material and also perceptible pedogenic manifestations (Table- 1). This indicates that free oxides in dune field soils were associated with sand fraction unlike P_1 to P_3. Estimation of Fe-d in sand and clay fraction of a few soils showed that clays of Gajsinghpura, Chirai and dune soils contained 1.5, 1.3 and 1.0% Fe_2O_3. When computed on clay content basis 70, 35 and 7% of Fe-d was found to be associated with clays of these soils, respectively. Brownish coatings on sand grains (observed under microscope) and on clays (observed under electron microscope) provided supporting evidences. Uniform distribution of Fe forms with depth and low Fe-d/Fe-t ratio in dune field soils suggest that oxides are not due to in situ weathering but inherited alongwith the sediments during their formation in Holocene period by break down of coarse textured alluvial plain (Dhir et al., 1977).

Palaripichkia soil (P. 7) developed on denudated sandstone also showed Fe-d maxima in horizon of maximum clay content as in P_1 to P_3, but increasing extractabiliy ratio (Fe-d/Fe-t) with depth upto weathering zone, show that accumulation was also due to weathering beside illuvial accumulation of clay.