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Distribution of Magnesium Fractions in the Nilgiris Soil Profiles: II. Distribution in Typic Palehumults

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In most of the profiles, the total Mg and the magnesium fractions were either consistent throughout the profile or gradually decreasing with depth. In most of the instances organic cycle was present. Reserve (acid-soluble) magnesium was observed to be got released during weathering.

In Doddabetta soils adequate amounts of reserve magnesium was present even in the sub-soil indicating the presence of basaltic parent materials. This needs further study. Clay pan was present in Ward's Gate profile characterised by accumulation of total Mg and its various fractions, associated with high clay.

The detailed examination of the profiles of the Nilgiris was conducted with a view to assess the distribution pattern of the discrete forms of magnesium in the profiles and to evaluate the pedogenic processes. In this paper the profiles observed in the soils of the sub-group Palehumults are taken up for discussion.

MATERIAL AND METHODS

The details of the location and the method of investigation were furnished in part I of the paper. In this investigation, profiles in localities Bembatty, Wardsgate, Ebbanad, Thuneri and Doddabetta (bottom) portions were examined. The data on the forms of magnesium are furnished in Table 1. The values expressed as percentages of the total Mg and total inorganic Mg are detailed in Table 2. The distribution pattern of different forms of magnesium in the plough layer would be more meaningful in terms of crop production. For this purpose, therefore, samples from horizons upto 25-35 cm depth were regarded as "top soil" and the samples below this as "sub-soil". Instead of individual profiles, group averages of the sub-groups were calculated (Table 3).

RESULTS AND DISCUSSION

This sub-group is represented by soils of the localities Bembatty, Wardsgate, Ebbanad. Thuneri, and Doddabetta bottom portions. The distribution pattern of the fractions of Mg in the profiles are described Wide variation in the pattern of distribution of magnesium among the profiles was observed. The variations might be attributed to parent material, Durairaj

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(1964) reported that the soils of Nilgiris varied markedly even within a small area. The occurance of Kaolin and sesquioxide in highly localised pocket suggested that the soil variations could be accounted for in the parent rock composition. This view is in consonance with the known properties of charnockite, the parent rock of most Nilgiris soil which is known to vary considerably from acid to ultrabasic conditions (Wadia, 1939).

Surface soil of Bembatty profile(1)* contained medium Mg_m and high Mg_r, Mg_e, Mg_{oc} and Mg_t. All the fractions tended to gradually decrease down the profile. Similar distribution pattern was observed by Aderikhin and Belyayev (1974) in Chernozem soils. Larger proportion of Mg_t consisted of Mg_{oc} (26 9 - 64.2 percent followed by Mg_{me} (16.7 - 27.8 per cent). This was indicative of a stronger organic cycle. This was in line with the observatios reported by Metson (1977), Wardegate profile (8) contained higher amounts of inorganic fractions of magnesium. Correspondingly, it contained higher amounts of clay (47.2 to 64.3 per cent). A positive correlation was obtained between clay content and Mg_m and Mg_e, This was in line with Bolton (1973). In this profile, a tendency towards a gradual decrease of all the fractions with depth was observed but for a layer of accumulation of Mg_t at 7.5-55 cm depth. This was associated with clay accumualtion.

In Ebbanad profile (11), 36 to 43 per cent of Mg_t consisted of Mg_m. About 26 to 43 per cent of the Mg_t was comprised of Mg_{oc}. Fairly consistent amounts of Mg_m, Mg_r and Mg_t were observed throughout the porfile. Such a distribution pattern was indicative of moderate weathering and the presence of organic cycle. Thuneri profile (12) contained medium amounts of all fractions in the surface layer. The major component was Mg_m constituting 34.7 to 47.4 per cent of Mg_t and was fairly consistent throughout the profile. The amount of Mg_r tended to decrease very gradually down the depth while Mg_e decreased substantially from 2.0 to 0.2 me/100 g soil. About 28.0 to 36.8 per cent of Mg_t was accounted by Mg_{oc} alone. This indicated the presence of organic cycle and a highly weathered surface soil lying over much unweathered parent material as indicated by negligible amounts of Mg_e at the lower depths. This was in confirmation with the reports of Metson and Gibson (1976),

Doddabetta profile (15) examined at the base of the hillock consisted of high amounts of all the magnesium fractions in the surface soils except Mg_r which was medium. About 28.1 to 60.5 per cent of Mg_t and 42.0 to 74.3 per cent of the total inorganic magnesium was contributed by Mg_m in the different horizons. The fraction Mg_m increased slightly with depth except for a small layer of accumulation of 30 -50 cm depth associated with higher amount of clay (45.6 per cent). Christenson and Doll (1973) also stated that magnesium concentration increased as the mechanical size of fraction decreased. Reserve magnesium (acid-soluble) constituted 18.6 to 31.8 per cent of Mg_t and 22.9 to 36.5 per cent of the total inorganic magnesium' A weekly weathered parent mateiial was

* These indicate profile numbers as noted in the figures 2 to 6

indicated by Mg_r increasing with depths and negligible amounts of Mg^e in the sub-soils. However, the surface layer was more weathered as indicated by higher amounts of Mg_e. Higher amounts of Mg_{oc} decreasing with depth might be due to organic cycle. Presence of higher amounts of Mg^r at the bottom horizons were observed in this profile which was indicative of the basaltic nature of the parent rock. Acid-soluble Mg fraction (Mg^r) was estimated in the solution by boiling with 1 N HNO_3, which dissolved all the basaltic rocks that are basic in character. Durairaj (1964) recorded the parent rock in the region as charnockite. It has been recognized by Wadia (1939) that due to variation in the proportion of the constituent minerals of the charnokite-type rock, several variaties with composition ranging from that of an acid or intermediate hypersthene granite (typical charnockite), through several gradations of increasing basicity to that of ultra-basic pyroxenites were possible. Presence of high amounts of Mg^r indicate that the soils are adequately suppli- with reserve magnesium.

The mean Mg_m of the top soil was lower than that in the subsoil suggesting weathering process was faster in the top soil. This was corroborated by the observation that top soil Mg_r was higher than sub-soil Mg^r suggesting release of Mg from the mineral form the mineral form to the reserve pool. Higher degree of weathering was further reflected the observation Mg_e and clay content were more in the surface soil than in the sub-soil. The above observation coupled with high Mg_{oc} and Mg_t in the surface soil than in the sub-soil was indicative of the active participation of organic cycle in thensoil magnesium distribution and cousequently soil development. Similar obsarvations were made by Blackmore and Miller (1962), who reported that Mg^e in the top soils was associated with organic cycle return while sub-soil Mg_e is often depleted to low levels by leaching and crop removal

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Table 1. Distribution of Magnesium Fractions in the profile samples (me/100 g, moisture free basis)

Locality	Profile No.	Depth (cm)	Mineral Mg	Acid soluble Mg	Exchangeable Mg	Organic complexed Mg	Total Mg (Summation)	Total Mg (Estimated)	CED (me/100 g)	Ex. Ca me/100 g
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Sematty	1	0-10	2.5	2.7	2.4	2.8	10.4	10.6	13.3	8.6
		10-30	2.3	2.1	0.8	3.1	8.3	9.0	15.2	5.3
		30-120	1.5	0.5	0.8	2.6	5.4	5.9	11.5	4.6
		120-260	0.8	0.2	1.2	2.6	4.8	4.9	16.1	3.9
		260-500	1.3	0.3	0.6	4.3	6.7	6.8	5.3	5.3
Warbesgate	8	0-8	2.2	1.5	1.6	1.6	6.9	6.3	14.9	6.6
		8-30	3.0	1.7	2.4	1.5	8.6	8.1	9.7	3.9
		30-90	2.8	2.3	0.2	1.2	6.5	6.5	10.0	4.6
		90-200	2.5	1.0	0.8	1.3	5.6	6.4	10.2	2.6
Ebbanad	11	0-10	2.7	0.7	2.8	3.2	7.4	7.6	11.6	2.5
		10-35	2.9	0.8	0.8	2.2	6.7	6.9	9.8	2.6
		35-70	2.9	1.3	1.2	1.9	7.3	7.6	9.4	3.9
		70-165	2.6	1.3	0.8	2.1	6.8	7.0	11.6	2.0
Thuneri	12	0.15	2.6	0.9	2.0	2.1	7.6	7.5	11.0	5.3
		15-40	2.9	1.0	0.8	2.4	7.1	8.0	12.2	4.6
		40-75	2.9	1.2	0.8	2.4	7.3	7.6	11.9	2.6
		75-100	2.8	1.3	0.2	2.0	6.3	6.6	10.1	2.6
		100-200	2.7	0.7	0.2	2.1	5.7	6.2	8.8	3.3
Doddabetta (bottom)	15	0-15	3.4	2.3	2.4	2.5	10.6	10.1	18.2	4.6
		15-30	2.3	1.7	1.6	2.3	7.9	8.6	21.7	8.6
		30-50	5.2	1.8	0.2	1.6	8.6	8.9	15.2	3.3
		50.65	4.6	2.5	0.2	1.2	8.6	8.5	16.4	3.3
		65-185	4.3	2.7	0.4	1.1	8.5	9.0	19.1	2.6

TABLE. 2. Forms of Magnesium in the Soil Profiles Expressed as Percentage of the Total Magnesium and total Inorganic Magnesium

Profile No.	Locality	Depth	Percentage of the total Mg				Percentage of the total inorganic Mg		
			Mineral Mg	Acid Soluble	Exchangeable Mg	Organic complexed Mg	Mineral Mg	Acid Soluble	Exchangeable Mg
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
1	Bembatty	0–10	24.0	26.0	23.1	26.9	32.9	35.6	31.6
		10–30	27.7	25.3	9.6	37.3	44.2	40.4	15.4
		30–120	27.9	9.3	14.8	48.1	53.6	17.9	28.6
		120–260	16.7	4.2	25.0	54.2	36.4	9.1	54.5
		260–309	19.4	4.5	11.9	64.2	54.2	12.5	33.3
8	Wardagate	0–8	31.9	21.7	23.2	23.2	41.5	28.3	30.2
		8–30	34.9	19.8	27.9	17.4	42.3	23.9	33.8
		30–90	43.1	35.4	3.1	18.5	52.8	43.4	3.8
		90–200	44.6	17.9	14.3	23.2	58.1	23.3	18.6
11	Ebbanad	0–10	36.5	9.5	10.8	43.2	64.3	16.7	19.0
		10–35	43.3	11.9	11.9	32.8	64.4	17.8	17.8
		35–70	39.7	17.8	16.4	26.0	53.7	24.1	23.2
		70–165	38.2	19.1	11.8	30.9	55.3	27.7	17.0
12	Thunderi	0–15	34.7	10.7	26.7	28.0	48.1	14.8	37.0
		15–40	40.8	14.1	11.3	33.8	61.7	21.3	17.0
		40–75	39.7	16.4	11.0	32.9	59.2	24.5	16.3
		75–160	44.4	20.6	3.2	31.7	65.1	30.2	4.7
		160–200	47.4	12.3	3.5	36.8	75.0	19.4	5.6
15	Boddebette (bottom)	0–15	32.1	21.7	22.6	23.8	42.0	28.4	29.6
		15–30	29.1	21.5	20.3	29.1	41.1	30.4	28.6
		30–50	60.3	18.6	2.3	18.6	74.3	22.9	2.9
		50–65	54.1	29.4	2.4	14.1	63.0	34.2	2.7
		65–185	50.5	31.8	4.7	12.7	58.1	36.5	5.4

Table 3 : Mean distribution of Magnesium Fractions in top and subsoils of each of the soil Taxonomical subgroup

Soil sub group	No. of profiles (average)	Magnesium content (me/100 g soil)					Clay content %
		Mineral	Acid-soluble	Exchangeable	Organic-complexed	Total	
Typic Palehumults	5						
Top soil		2.7	1.5	1.7	2.3	8.2	46.5
Sub soil		2.9	1.3	0.0	1.0	6.8	45.6
Mean		2.8	1.4	1.2	2.0	7.5	