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Chemical and Mineralogical Studies of Pseudo-gleyed Soils on Riss Moraine near Langenthal (Swiss Plateau)

DISSERTATION

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Merwe and Heystek (1956) reported kaolinite, montmorillonite and illite-montmorillonoid mixed minerals in some South African podzolic soils.

Gieseking (1949) studied the stability of the montmorillonitic minerals in some very young calcareous loessial clays developed under grass vegetation. Before electrodialysis these clays gave intense characteristic basal spacings for montmorillonitic group of minerals, but after electrodialysis no sharp intense characteristic basal spacings were obtained. From these experiments it seems that the more perfect montmorillonitic crystals are rather unstable, and that they partially decompose to form a type of pseudo-montmorillonitic crystal under the acidic destructive forces.

According to Jackson et al. (1948), the stability series or weathering sequence of minerals present in the colloids of soil is represented by the following thirteen stages of type minerals: gypsum, calcite, hornblende, biotite, albite, quartz, illite, mica-intermediate, montmorillonite, kaolinite, gibbsite, hematite, and anatase (corundum).

According to Grim (1953), if the leaching of magnesium is relatively rapid, montmorillonite will be an initial stage of weathering and kaolinite a later stage.

No satisfactory explanation could be given as to the occurrence of montmorillonite in A_1 of profile 1 and in C_1 of parent material. Perhaps, montmorillonite is formed in an early stage of weathering and is destroyed during the further soil formation. If this was the case montmorillonite would have to be reformed in A_1, but the conditions do not seem to be favourable for that. However, the low K_2O content in A_1 of profile 1 (see Table 7, p. 26) corresponds to the formation of montmorillonite (Grim, 1953).

6. SUMMARY

A pseudogleyed para brown earth under a beech forest and a pseudogley under a spruce forest near Langenthal (Swiss plateau) were analysed. The analyses were extended to a sample of a deep laying stratum of little weathered, gravelly Riss morainic material found at a short distance from the profiles.

From the content of the fine sand fractions 0.1 - 0.05 and 0.05 - 0.02 mm

and from their zircon content as well as from heavy minerals percentage of soil of both A and B horizons of the two profiles, it is concluded that the two profiles have developed from uniform parent material.

The zircon percentage of heavy minerals in the fine sand fractions of the Riss morainic material suggests that this may be a source of the parent material of the two soil profiles. The TiO_2 content of the clay fractions of all horizons of the two profiles as well as of the clay fractions of C_1 and C_2 of the Riss morainic material confirms uniformity of parent material of the two profiles.

From chemical compositions, C.E.C., thermogravimetric analyses, D.T.A. curves and x-ray diffraction pattern of the clay fraction, kaolinites, illites and chlorite together with quartz are indicated in all horizons of the two profiles. Small amounts of montmorillonites and vermiculites are present in A_1 of profile 1. Illites, chlorite and montmorillonites are found in C_1 and illites and chlorite in C_2. Quartz is also present in both C_1 and C_2.

The experiments suggest that the differences in soil type and vegetation are not due to differences in parent material or in composition of clay minerals which may be inherited from parent material or formed during soil formation.

ZUSAMMENFASSUNG

Die Untersuchung umfasste eine pseudovergleyte Parabraunerde unter einem Buchenwald und einen Pseudogley unter einem Fichtenforst in der Nähe von Langenthal, sowie frischen Rissmoräneschotter aus der Nähe der beiden Profile.

Aus dem Anteil der Fraktionen 0,1-0,05 mm und 0,05-0,02 mm sowie aus deren Zirkongehalt, ferner aus dem Schwermineralanteil des A- und B-Horizontes der beiden Profile wurde geschlossen, dass die beiden Profile aus einheitlichem Muttergestein entstanden sind.

Der Zirkonanteil an den schweren Mineralien der beiden Feinsandfraktionen des Moränematerials deutet darauf hin, dass das Muttergestein der beiden Profile aus der Moräne stammen kann.

Der TiO_2-Gehalt der Tonfraktionen aller Horizonte der beiden Profile und der beiden Moräneproben bestätigen die Einheitlichkeit des Muttergesteins.

Aus der chemischen Zusammensetzung, der Kationentauschkapazität sowie aus den Daten der Thermogravimetrie, Differentialthermoanalyse und der Röntgendiffraktometrie ergibt sich, dass Kaolinit, Illit, Chlorit und Quarz in der Tonfraktion aller Horizonte der beiden Profile vorhanden sind. Geringe Mengen von Montmorillonit und Vermikulit sind im A_2-Horizont der Parabraunerde vorhanden, Chlorit und Montmorillonit im C_1 und Illit und Chlorit im C_2. Quarz kommt auch im C_1 und im C_2 vor.

Die Ergebnisse deuten darauf hin, dass die Unterschiede im Bodentyp und in der Vegetation nicht auf Unterschieden des Muttergesteins oder des Tonmineralbestandes beruhen.