SOILS OF SOUTH-CENTRAL CHILE

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The main soils in the south-central part of Chile are those with udic and perudic moisture regimes, which form the most important areas where the volcanic ash soils are developed. Nevertheless it is known there are also Andisols with xeric moisture regimes.

The soils with udic moisture regime extend throughout the piedmont of the Andean Mountains, the Central Valley, and the Coastal Cordillera from 38° to 42° S latitude. The soils with a perudic moisture regime are distributed along a narrow belt of north-south direction at a higher altitude than the Andean Piedmont; and also from 42° to 52° S latitude throughout the region of fiords. However, no precise data are available with regard to this regime.

Between 33° to 42° S latitude Chile contains three fundamental physiographic units: the Andes Mountains, the Central Valley, and the Coastal Cordillera. The three regions show very distinct characteristics. The soils developed in those units differentiate themselves because of differences mainly due to parent material, relief, and time.

SOILS OF THE COASTAL CORDILLERA

Three different parent materials can be identified in this area: metamorphic rocks, granitic rocks, and old volcanic ash.

Moderately to strongly weathered micaschist forms the parent material for many important soils of the area. According to different surveys the pH of those soils is always below 5.5, the cation exchange capacity is around 25 meq/100 g of soil and decreases with depth. The total iron expressed as Fe_2O_3 is about 14%. The soils developed on this micaschist make up a rather extensive soil association and some of its members qualify as Paleudults and others as Thodudults. There are some areas where the strong weathering and the intense leaching have formed a strongly developed coarse-textured albic horizon. In these cases the underlying horizon is too weakly developed to meet the levels of accumulation of an argillic or a spodic.

The soils developed over granite normally have a high clay content that decreases regularly with depth below the argillic horizon. The pH is around 5 and the iron content is smaller than in the soils derived from micaschist. When they have a xeric moisture regime they meet the requirements of Palexeralfs and Haploxeralfs. In more humid conditions they qualify normally as Hapludults.

The last group of soils in the Coastal Cordillera are those derived from old volcanic ash. Different authors agree that this is the common parent material for an important group of soils. The clay fraction is dominated by metahalloysite, halloysite, and kaolinitic materials, assuming that this mineralogical suite corresponds to the weathering of the volcanic glass. The presence of fresh volcanic glass at different depths in the soil profiles is interpreted as recent rejuvenation due to modern events.

The most relevant research has been carried out by Dr. Eduardo Besoain who has proposed the following weathering sequence for the volcanic glasses in Chile: volcanic ash (glass) - allophane, imogolite - halloysite - kaolinite. These old volcanic ash soils have been reported over andesitic or basaltic tuff and also over highly weathered conglomerates of cobbles and pebbles. High clay contents of kanditic type are very common in the weathered rocks. The majority of these soils are located on the east side of the coastal cordillera. Considering the soils of this physiographic unit as a whole, the most striking feature, common of a great number of them, is the red color. Normally they are in the 5 YR of the Munsell Color Chart and many of them are in the 2.5 YR. This is the reason why they have locally been given the name of "red clay soils" in the first years of the colonization. They also have in common a rather high clay content and argillic horizons with prismatic to blocky structure.

SOILS OF THE CENTRAL VALLEY

Elevations in the Central Valley fluctuate from 25 m.a.s.l. to 300 m.a.s.l. and the relief varies between nearly level (0-1%) to moderately steep (20%). In the area with a xeric moisture regime, the soils have reached a higher degree of evolution, and argillic horizons are frequent. In wetter areas, volcanic ash soils dominate and are found with different degrees of evolution, each of which occupies different physiographic positions and are subjected to different drainage conditions.

The youngest volcanic ash soils normally have a cambic horizon which is very weakly developed. They are generally deep soils over andesitic tuff on usually convex slopes of less than 15%. Most of them qualify as Dystrandepts.

In landscapes with undulating relief, other volcanic ash soils with a higher degree of evolution have been identified. In these soils the allophane continues as the dominant clay mineral, but is associated with metahalloysite. This is interpreted as a more advanced stage of evolution, assuming that this mineral comes from the weathering of the allophane. In addition, the structure in the cambic horizon is more strongly developed and the bulk density is near to one. We think that this type of soil is at the boundary of the Andisol concept, even though they still show some andic properties like high rates of phosphorous retention.

Important areas of the Central Valley are found occupied by a particular type of soil derived from volcanic ash, locally known as "ñadis." The ñadis are located in sectors with low relief, level to nearly level, characterized by excessive wetness for prolonged periods during the year.

The ñadis are thin (25 to 50 cm) to moderately deep soils (50 to 100 cm) with clear horizon differentiation. The epipedon with a high organic matter content seldom qualifies as histic, because it does not have enough thickness. There is a dark brown Bs, normally with subangular blocky structure over a distinct yellowish B which rests abruptly on a placic horizon. The subtratum is a glacifluvial deposit that corresponds to the outwash of the piedmont glaciers. Under some local drier conditions, the upper part of this deposit is strongly cemented into a duripan.

There is one more morphological feature that characterizes this particular type of soil -- the placic horizon, present as a black to reddish-black, thin layer (from 1 to 5 cm thick) between the high-chroma B and the glacifluvial deposit.

Normally these soils have a high chroma and for that reason would not meet the color requirement to be classified as Aquand according to the ICOMAND (Circular No. 5). In addition, the epipedon seldom qualifies as histic and the flacifluvial deposit is not always indurated into a duripan. Furthermore, the soils are usually saturated with water more than half of the time, which is enough to be considered as having an aquic moisture regime. Thus, at present time there is no place for this type of soil following Circular No. 5. Our feeling is that Placaquand could be the best great group that represents in a precise way the conditions of the ñadi soils, taking into account that the placic horizon is the actual restricting layer.

SOILS OF THE ANDEAN MOUNTAINS

In this sector, two main subsectors can be recognized; first, the Andean Mountains Piedmont, located between the great mountains and the Central Valley; and second, the Andean Mountains proper.

The piedmont is characterized by rolling to hilly landscapes, with slopes between 10% to 35%. It is normally dissected by numerous streams of east-west direction; the slopes that face the streams are very steep and the soils vary considerably in depth. Some of them are developed over strongly cemented tuff. Medium to fine textures with high to very high water retention capacity and bulk densities lower than 0.8 are common features of these soils. In our opinion, most of them correspond to the central concept of the Typic Dystrandepts.

Some of the soils show a clear layering produced by the successive deposition of the volcanic ashes. In general the degree of evolution of the soils is rather incipient. Allophane and imogolite have been described as dominant minerals in the clay fraction. There is also some chlorite. The Durandepts are present in those areas where the tuff is found in the upper meter, and usually all the soils are in the medial families.

The other subsectors, the Andean Mountains proper, is characterized by a strong relief, with slopes over 25%; the valleys are narrow and confined. The parent materials are normally coarser volcanic materials than the ashes, like cinders and lappillis; in addition, there are scorias and lavas. Consequently, the cindery families are frequent. Most of these soils show only a thin accumulation of organic residues at the surface. They are shallow to very shallow over volcaniclastic materials and we can say that these are the least developed of all the volcanic soils.

The majority of these recent soils presently do not qualify as Andepts because the epipedon is too shallow to be considered as umbric. It seems logical to accommodate these recent soils on volcanic materials with the Entisols, considering they do not have any kind of diagnostic features.

This has been only a brief review of the main landscapes and the associated soils of the south-central region of Chile, taking into account the most relevant properties of them. There have been surely some omissions and this review is not a comprehensive one, but the time available only allowed for showing the most striking features of the soils and the general distribution of them.

ANALYTICAL METHODS

The following is a brief description of the procedures and methodology used by the National Soil Survey Laboratory. It a more detailed description of any procedure is needed, the following report should be consulted. "Soil Survey Investigations Report No. 1, Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples," USDA, SCS, Revision, August 1982. For equivalent procedures but ones of a less automated and instrumented nature, the 1972 revision should be consulted.

Method codes are included in the column headings on the data printouts and can be used as a key to the methods and procedures.

Some general comments on how the samples are handled:

All samples are air-dried and crushed using a wooden roller and sieved to remove fragments greater than 2 mm in diameter. All determinations are made on sieve samples and reported on an ovendry weight basis unless otherwise stated. The ovendry weight basis is determined by ovendrying a sample at 105°C.

CONSIDERATIONS IN THE USE OF LABORATORY DATA

In consideration of the soil characterization data, be aware of the ways your concepts of specific properties compare with the same properties defined operationally. Each of us has mental pictures and conceptual definitions to aid in visualizing properties and processes. These frequently go far beyond the information supplied by any particular analysis, and we are tempted to give numbers on paper credit for connotations that are strictly our own. In this light, there are two pitfalls. One is the temptation to mix observations with concepts. Rather than first laying down observations and then building inferences, it is tempting to describe and interpret in terms of predetermined inferences. If, at some later date concepts change, there may be no way to untangle the observations from the outdated concepts to piece together new inferences.

The second pitfall is the temptation to remain unaware of the operations (analyses) involved in an observation or measurement. Results differ with different methods, but the nature of any particular operation remains the same so long as the same method is used. To compare one bit of data with another, it is important to know how both bits were gathered. This leads to operational definitions (methods). The operational definition is a device to describe a soil property in terms of the operations used to measure it. Look for operational and conceptual definitions as we discuss the following laboratory analyses. Then, as we use field and laboratory data to classify soils, we can attempt the difficult task of separating observations from concepts.