THE BRAZILIAN CLASSIFICATION OF LATOSOLS

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Effective soil surveys in Brazil started in the 1950s. The extensive territory, the scarcity of soil scientists, and the urgent need for soil resources information directed at agricultural development led to opting for small scale, low intensity reconnaissance surveys. The need then arose for soil classification at relatively high categorical levels.

The reference base adopted, and later adapted, was the great group and suborder levels of the then official Soil Conservation Service, U.S. Department of Agriculture (SCS/USDA) system (Baldwin, Kellogg, and Thorp 1938) and added modifications (Thorp and Smith 1949). The noun *latosols*, applied to a grouping of tropical soils, has been inherited from a subsequent attempt toward modification of the SCS system (Kellogg 1949).

In the early days, the attempt to perform small scale, extensive, speedy soil surveys through prefixed legend very soon proved unsatisfactory. Thenceforth, the influence exerted by the open and evolving legend model, as required by the envisaged soil survey, imparted parallel adaptations in the reference soil classification scheme.

Within this context, reflexes in Latosols identification and discrimination have been of considerable concern, even more so at present, because of more complete knowledge of their known or hoped for distinctions, and because of their diversified distribution in the country. As major coexisting soils of common frequency within about one-third of the territory, Latosols occur from equatorial humid regions through tropical semiarid, semihumid regions, and subtropical humid mesothermal regions (perudic isothermic), even sometimes subject to light occasional snow falls (Fig. 1).

Course to Present

Initially, the Latosols, like the other main soil classes (great groups), were identified through correlation of soil profile morphological characteristics aimed at distinguishing broad mapping units (primarily soil and secondary relief landscape traits). The standing reference pedon was a specimen identified as modal by R.W. Simonson (pers. comm. 1954), now named a Typic Acrusthox according to *Soil Taxonomy* (Soil Survey Staff 1975). This being the case, the central concept established was pertinent to a highly weathered soil having a deep solum with slight to almost no textural differentiation from the surface downward; faintly expressed horizonation other than from A to B major horizons; and rather gradual to diffuse transitions. Moreover, throughout the very porous B horizon, outstanding in the soil profile due to its intense yellowish red color, the pedon exhibits soft (dry) very friable (moist) consistence, and peculiar undistinctive peds, its structure consisting of very small size aggregates.

The concept essentially had a morphological expression (Barros et al. 1958), undergoing improvement by Bennema, Lemos, and Vettori (1959), much of it being set in contradistinction to the Red-Yellow Podzolics great group (Lemos et al. 1960; Camargo et al. 1962), that is, soils characterized by latosolic B horizons versus textural B horizons. The concept formulation designed for African soils by Kellogg and Davol (1949) stood as a concurrent reference.

Since then, not much diversion has been allowed within the conceptual framing of the overall class of Latosols in Brazil. By and large, a lasting "sense of purity" has been attained by most of the soil surveyors, actually not numerous. A broader conception has been the preference of a few Brazilians, mainly bearing on lateritization/ferralitization processes and related classes of ferralitic soils (Commission de Pédologie et de Cartographie des Sols 1967).

With the progress of soil surveys in the country and the building of knowledge in the little known world of tropical soils, bits of information were added till the middle 1960s which were pertinent to implementation of analytical characterization and coupled to attempts to set apart various types of Latosols in the undeveloped category of subgroups. This has proceeded simultaneous with and through some shared pathways of development toward the 7th Approximation (Soil Survey Staff 1960) up to *Soil Taxonomy* (Soil Survey Staff 1975).

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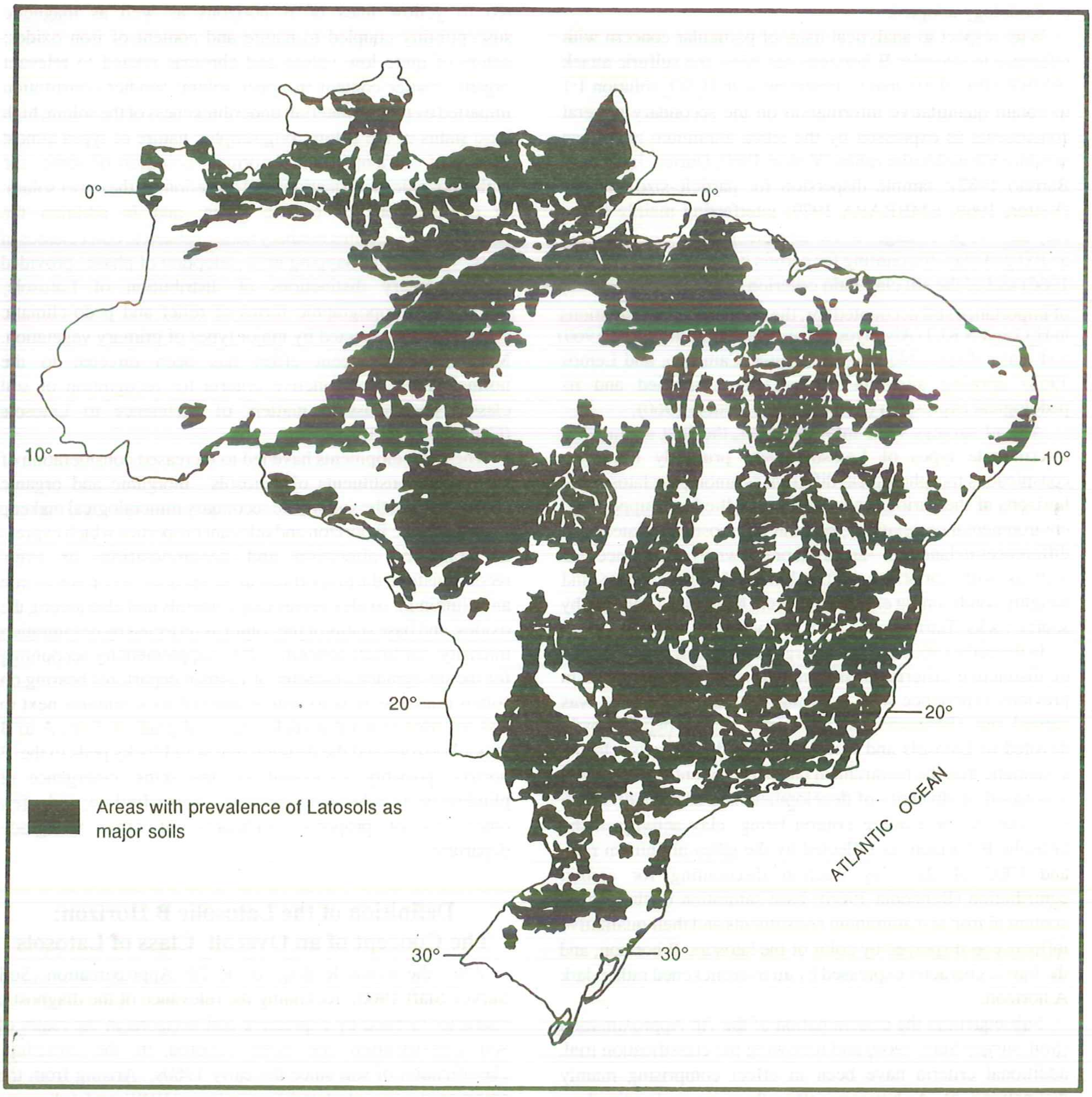

Fig. 1. General view of the territorial extent in Brazil where Latosols constitute the main coexisting soils (after Lepsch and Buol 1987).

Morphological and analytical data accumulation provided means to (1) more fully appraise the characterization of a possible central concept, as refers to the overall taxon of Latosols, (2) notice departures and conceive possible lower rank groupings, and (3) get familiar with ranges in variation and learn of relationships among analytical data produced by the methodology adopted.

With respect to analytical data, of particular concern with reference to latosolic B horizons has been: the sulfuric attack (EMBRAPA 1979), that is, treatment with H_2SO_4 solution 1:1 to obtain quantitative information on the secondary mineral constituents as expressed by the silica aluminum and silica sesquioxide molecular ratios (Vettori 1969; Duriez, Johas, and Barreto 1982); sample dispersion for particle-size analysis (Vettori 1969; EMBRAPA 1979) interferring mainly in the clay and silt percentages to the detriment of the CEC reported to 100 g of clay discounting for carbon contribution (Bennema 1966) and of the silt clay ratio criterion (Van Wambeke 1962) of importance still accounted for; the ΔpH from determinations in H_2O and N KCl (Alvahydo 1959; Bennema and Vettori 1960) and water dispersible clay (Bennema, Camargo, and Lemos 1958) drawing attention to the factors implied and its pedological expression (Bennema and Vettori 1960).

As soil surveys went into operation, the first attempts to discriminate types of Latosols were primarily based on conspicuous morphological differences among the latosolic B horizons of the various soils, and were allied to "supporting" environmental correlations, particularly those associated with differences in land use—apparent or known by experience—as well as with variations in the binomial relief-climate and weighty conditioning exerted by parent material as imposed by source rocks (Barros et al. 1958; Lemos et al. 1960).

In the early 1960s a tentative organization and consolidation of distinctive criteria to discriminate soil classes, based in previous experience with mapping units in the surveys, was carried out (Bennema and Camargo 1964), being mostly devoted to Latosols and Red-Yellow Podzolic soils. In the systematic trial the hierarchical pattern pertinent to the Latosol was based on diversity of development and essence of solum constitution, the leading criteria being: clay activity in the latosolic B horizon, as reflected by the silica-aluminum ratio and CEC of the clay fraction discounting for carbon contribution (Bennema 1966); base saturation of the solum; content of iron and aluminum constituents and their qualitative influence as displayed by color of the latosolic B horizon; and the humic character expressed by an overthickened rather dark A horizon.

Subsequent to the dissemination of the 7th Approximation (Soil Survey Staff 1960) and following the classification trial, additional criteria have been in effect comprising mainly distinctions of A horizons after the types of epipedons introduced by the 7th Approximation, the major grouping of textural classes, and some improvements in the recognition of intergrades. In this regard, a crucial problem occurred and still remains in the domain of the intergrades. It concerns the proper and needed criteria for easy distinction of Latosols and Red-Yellow Podzolics intermediate soil departures. On the other hand, not many problems were caused by interfaces to "intrazonal" great soil groups, that is, Low Humic Gleys and Ground Water Laterites (more recently encompassed by Plinthosols), but they were somewhat more troublesome to the Sol Brun Acide (presently part of Cambisols).

Along these lines, criteria applied to distinguish types of Latosols as lately summarized by Jacomine (1979) centered on red to yellow hues of B horizons as well as magnetic susceptibility coupled to nature and content of iron oxides; colors of quite low values and chromas related to relevant organic matter content in upper solum; sandier constitution imparted by parent material; underthickeness of the solum; high base status of the solum; oligotrophic nature of types almost devoid of nutrients; the "abnormal" cohesion of some; the anthropogenic modifications and accretions in the upper solum; or combinations of criteria given; and in addition the recognition of the intermediary nature related to other classes of soils. In terms of mapping units, adoption of phases provided complementary distinctions of distribution of Latosols, according to topographic forms of relief and pedo-climatic conditions, as reflected by major types of primary vegetation. More broadly, recent effort has been directed to the normalization of distinctive criteria for recognition of soil classes encompassing matters of pertinence to Latosols (Carvalho et al. 1986).

These developments have led to increased consideration of the major constituents of Latosols—inorganic and organic components of the solum; the secondary mineralogical makeup of the latosolic B horizon and relevant properties which express its stage of alteration and decomposition, or even recombination; the proportions in the latosolic B horizon of iron and aluminum oxides versus clay minerals and also among the oxides; and base status of the solum as reflected by desaturation intensity. Of future concern will be supplementary accounting for the intergraded character of Latosol departures bearing on solum thickness next to semiweathered rock remains next to less resistant mineral particles; textural gradient from A to B major horizons and the distinctiveness of blocky peds in the B horizon possibly associated to clay skins; emergence of plinthite or its indurated succedent—petroplinthite; and a few other sets of properties indicative of other intergrade departures.

Definition of the Latosolic B Horizon: The Concept of an Overall Class of Latosols

After the trends leading to the 7th Approximation (Soil Survey Staff 1960), reckoning the relevance of the diagnostic character merited by expressive soil horizons in the realm of soil classification has been favored in the Brazilian classification of soil since the early 1960s. Arising from the embryonic concept stated by Kellogg (1949) and following implementation by Bennema, Lemos, and Vettori (1959), succeeding formulations (Lemos et al. 1960) and progressive refinements established the current definition of the latosolic B horizon.

In summary, the latosolic B horizon is a subsurface mineral horizon, exclusive of the textural B or natric B horizons, gley horizon, and plinthic horizon, which constitute evidence of an advanced state of weathering, as shown by the complete or near complete alteration and decomposition of the less resistant primary and secondary minerals, intense desilication (otherwise preweathered parent material), leading to residual concentration of sesquioxides and/or 1:1 clay minerals, and coexisting with primary minerals moderate to highly resistant to weathering.

Holding close similarities with the nonhydromorphic and nonplinthic share of the oxic horizon of *Soil Taxonomy* (Soil Survey Staff 1975), it is a distinctive diagnostic B horizon which, exclusive of the criteria pertaining to textural B horizons, plinthic horizons, and gley horizons, meets these requirements[2] :

1. Contains in the fraction < 0.05 mm, as reported to the fine-earth fraction, < 4 percent of any easily weatherable primary minerals, or < 6 percent muscovite. Has only rather small proportions of silicate clay minerals less resistant to weathering than kaolinite, with some allowance for aluminum interlayered chlorite;
2. Has a silica-aluminum molecular ratio of the clay fraction, or referred to it ≤ 2.2 (often < 2.0);
3. Has an apparent cation exchange capacity (pH 7) of the fine-earth fraction of < 13 meq per 100 g clay after discounting for organic carbon contribution (Table 2);
4. Does not have more than 4 percent by volume of semiweathered rock fragments with altered constituents, or of rock structure remains;
5. Has texture of sandy loam or finer and silt-clay ratio ≤ 0.6 if clayey, or ≤ 0.7 if loamy;
6. Has a very fine to fine strong granular structure seemingly structureless, which may grade to subangular blocky, weak, or seldom moderately developed;
7. Has color often intense, of Munsell hues 2.5 Y or redder and chromas > 2, and if mottled has less than 15 percent by volume of plinthite or petroplinthite reddish bodies, and has less than 20 percent of mottles of chromas ≤ 2;
8. Is at least 50 cm thick (BA and BC horizons included);
9. Has transitions between subhorizons mainly diffuse or gradual, related to weak subhorizon differentiation.

Note that parameter(s) to exclude x-ray amorphous soil material are not developed, since uncertainties remain regarding occurrence of Andosols in Brazil.

In terms of general concept, as adopted in the Brazilian classification, Latosols are nonhydromorphic mineral soils that have a latosolic B horizon following any kind of diagnostic A horizon, but "turfoso" (histic) providing the requirements of Plinthosols are not met.

This class comprises soils that are rather developed, with mineral constitution of the solum which evidences the highly advanced weathered stage, being virtually devoid of primary and secondary mineral constituents less resistant to weathering. Hence these soils have low activity of coloidal mineral constituents, bear a low silica-aluminum molecular ratio (average expression of the whole secondary inorganic composition), and range from extremely weathered predominantly gibbsitic soils with values of about 0.1 to lesser weathered predominantly or entirely kaolinitic soil with values of about 2.0 rising up to 2.2. At the same time CEC values lower than 13 meq per 100 g clay (cf. Table 2) stand as an expression of the low activity, coloidal mineral constituents.

These soils are mostly rather deep (solum seldom < 1.5 m), ordinarily range from excessively to well drained, are composed of an A, B, C sequence of horizons, and show gradual or diffuse boundaries, particularly with subhorizons of the latosolic B.

Apart from the variable darkening in the A horizon, a colorful tendency prevails in the B, ranging mostly from yellowish brown to red tints (10 YR to 10 R hues).

The clay content shows a gradual increase downward in the solum; the increment from A to B is faint, the requirement for textural B horizon not being met. The silt-clay ratios are low (< 0.7), the higher rates tending to be related to decreasing clay content.

As a typical characteristic, mobility of clays is low, and, as expressed by the water dispersible clay, the flocculation rate in the latosolic B horizon is 100 percent or nearly so, rising atypically toward the A horizon by counterweighted influence of the organic matter (electro-negative charges surplus), or, occasionally, down the latosolic B horizon if the silica-aluminum and particularly the silica-sesquioxide ratio is rather low (electro-positive charges surplus), which is reflected by the pH, as pointed out by Bennema, Camargo, and Lemos (1958), Bennema and Vettori (1960), and Lemos et al. (1960). Atypical behavior might hold also for loamy-textured Latosols, more noticeably in those of coarser texture.

As a related feature, aggregates < 2 mm of granular shape impart a pseudostructureless appearance and a high porosity to the B horizon of the typical soils. Likewise, the wet consistence of the soil material is misleading—the initial low plasticity and stickiness of handled samples shows significant increase with intensified rubbing. Furthermore, consistence soft to slightly hard when dry and very friable to friable when moist is commonplace in typical Latosols.

Nevertheless, apart from the aforementioned typical pattern, the class also comprises soils that, in structure and consistence, stand as variant. Cohesion of B-horizon soil material may be stronger, structure may consist of moderately developed, subangular blocks, and consistence may range from very hard when dry, to firm when moist, with no deceptive character for the wet consistence.

Commonly, base saturation and exchangeable bases are low to extremely low in the solum, mainly in the latosolic B horizon. Some recharge of bases—cycling through vegetation—might concern primarily the A horizon. The soils concerned are usually strongly to extremely acid. High exchangeable aluminum saturation in the A horizon is very common, being variable in the B, tending to decreased proportions and eventual absence down the solum and the C horizon, being restrained by decreasing silica-aluminum and silica-sesquioxide molecular ratios, which raises the pH and the tendency to or prevalence of net positive charge.

High base saturation Latosols are scarce and are found primarily in climatic regions with a pronounced dry season, semiarid or not. They may also be found among the soil formed

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[2] No requirement given is limited solely to a latosolic B horizon.

from basic rocks, even though under moister climatic conditions.

Major Classes of Latosols: Distinction from Related Major Classes of Soils

Recognition of the various major classes of Latosols has been based on differences in the soil material constituting the latosolic B horizon. This composition is seen as a consequence of their origin and the intrinsic changes accounting for their production. Sets of properties, believed to be indicative of the actual composition of latosolic B horizons, stand as discriminant criteria.

Seven main subdivisions of the overall class of Latosols are presently recognized (Table 1).

Further subdivision of classes, through poorly systematized lower ranks, have been established based on criteria as specified, according to the major class of Latosols.

Ferriferous Latosols—Humic character; intergradational with Cambisols and Pertoplinthosols; prominent or moderate A horizon; texture fine, very fine.

Dusky Red Latosols—Humic character; high or low base saturation or high aluminum saturation; intergradational with *Terra Roxa Estruturada* (textural B soil), Red-Yellow Podzolics, Cambisols, Plinthosols, Dark Red Latosols, Ferriferous Latosols; underthickened solum, prominent, moderate, or chernozemic A horizon; texture very fine, fine, or seldom loamy.

Red Dark Latosols—Humic character; high or low base saturation or high aluminum saturation; intergradational with Dark Red Podzolics, Red-Yellow Podzolics, Cambisols, Red-Yellow Quartz Sands; prominent, moderate, weak, or seldom chernozemic A horizon; texture very fine, fine, or loamy.

Red-Yellow Latosols—Humic character; low or seldom high base saturation or high aluminum saturation; intergradational with Red-Yellow Podzolics, Cambisols, Plinthosols, Red-Yellow Quartz Sands, Gleysols; underthickened solum; prominent, moderate, or weak A horizon; texture very fine, fine, or seldom loamy.

Yellow Latosols—Humic character; low or scarcely high base saturation (semiarid region) or often high aluminum saturation; intergradational with Yellow Podzolics, Plinthosols, Red-Yellow Quartz Sands, Gleysols, Red-Yellow Latosols; anthropogenic character of the A and B upper horizons; prominent, moderate, or weak A horizon; texture very fine, fine, or, loamy.

Brown Latosols—Humic or cryptohumic character; low base saturation or high aluminum saturation; intergradational with Cambisols, *Terra Bruna Estruturada*, Dusky Red Latosols, Red-Yellow Latosols, Gleysols; underthickened solum; texture very fine or fine.

Latosols Una *variation*—Humic or cryptohumic character; low base saturation or scarcely high aluminum saturation; intergradational with Cambisols, Plinthosols, Red-Yellow Latosols, Dark Red Latosols; underthickened solum; texture very fine or fine.

Supplemental adoption of phases according to main types of primary vegetation constitutes a contrivance for additional discrimination on the basis of pedo-climatic conditions, chiefly concerning soil moisture regime.

Notwithstanding the long prevailing necessity, no practical means has been devised for field distinction of the more typical Latosols—more weathered (~acric in *Soil Taxonomy*) from not so severely weathered Latosols.

The conjunction of features of the latosolic B horizon, comprising strong, fine to very fine granular structure, seemingly by structureless, soft and very friable dry and moist consistence, gradational wet consistence, plus renitency to steady pressure have not been entirely successful for exclusiveness. Nevertheless, much support for distinction is met by indicative sets of analytical properties, namely, quite low silica-sesquioxide and silica-aluminum molecular ratios, insignificant CEC per 100 g clay after discounting for organic carbon contribution, a tendency toward or positive pH, and the absence, or virtually so, of exchangeable aluminum.

Actually, the needed distinction among these older varieties has remained the major shortcoming in the distinction of major classes of Latosols.

The distinction of Latosol varieties is approached in the field by indentification which accounts for color, particularly of the latosolic B horizon; attraction of the dry, well-crushed sample to a hand magnet; high or low base saturation in conjunction with high aluminum saturation of the solum, inferred from field pH determination coupled to experience concerning agricultural use of the lands, observation of crops, and recognition of primary vegetation types; recognition of intergradational morphological features displayed by the soil profile; inspection of sample under a hand-lens in search of clayskins, glazes, and primary mineralogical particles; recognition of type of A horizon; and texture estimated by feel. Decisive indentification is obtained through analytical characterization.

The essentials of distinction between Latosols and other related major classes of soils comprise the following:

1. Distinction from low activity clay Red-Yellow Podzolics, Red Podzolics, and Yellow Podzolics—These soils have a textured B horizon (argillic horizon in *Soil Taxonomy*) sequent to an A, AB, E, or EB horizon. Besides, contrary to Latosols, these soils when dry commonly show faded colors in the A and in the transition to the textural B horizon, eventually characterizing an E horizon. The different facies attained by Latosol intergrades to Podzolic soils are (a) expressed mainly by textural differentiation—clay increase—between A and the still latosolic B horizon; (b) prevalence of weak or seldom moderate subangular and rarely angular blocky structure throughout the B, associated with no more than few and faint or scarce and moderate clayskins, the last if present preferentially in vertical faces; (c) upper B as above, preceding a lower B horizon, pseudostructureless, though formed by strong, fine to very fine granular structure.
2. Distinction from *Terra Roxa Estruturada*—The presence of a textural B horizon sequent to an A or AB is the distinguishing mark. Although these soils have a textural B horizon, the clay increase from A to B is mostly

Table 1. Distinction of Major Classes of Latosols

	Differentiae concerning the B horizon						
		Color (exclusive of BA)					
Classes recognized at present	Fe_20_3[a] % wg. pertaining fract. < 2 mm. Referred to clayey soils[b]	Hue	Value	Chroma	Magnetic susceptibility[c] of dry, well-crushed sample < 2 mm	$Si0_2$-Al_2O_3 molecular ratio[a]	$Si0Al_20_3$ & Fe_2O_3 molecular ratio[a]
Ferriferous Latosols	≥ 36 (72)[d]	Redder than 4 YR	≤ 3	≤ 6	Wholly attracted	0.1 to 0.9	
Dusky Red Latosols	40 to 18	Mostly redder than 4 YR	Mostly ≤ 3	≤ 6	Strongly to wholly attracted	0.2 to 2.0	
Dark Red Latosols	18 to 8	Mostly redder than 4 YR	≤ 4.5	Mostly ≤ 6	Weak to virtually no attraction	0.2 to 2.2	
Red-Yellow Latosols	Mostly 11 to 7	Yellower than 1.5 YR	Mostly > 4.5	≥ 6	Virtually no attraction	Mostly < 1.5	< 1.4
Yellow Latosols	Mostly < 7	Mostly yellower than 6 YR	≥ 5	≥ 4	same	1.5 to 2.2	> 1.4
Brown Latosols	> 11 (30)[d]	Mostly yellower than 3.5 YR and reddening downward	3 to 4	≥ 3	same	0.7 to 2.2	
Latosols *Una* variation	> 11 (30)[d]	Mostly yellower than 3.5 YR	4 to 5	Mostly ≥ 5	Strong to virtually no attraction	0.2 to 2.0	

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[a] From attack by H_2SO_4 solution 1:1 (EMBRAPA 1979). Results pertaining to the clay fraction, though including sesquioxides contained in nodules, concretions, and coatings in fract. < 2 mm, plus negligible Fe_20_3 in ilmenite occasionally present.

[b] Al_20_3 - Fe_20_3 molecular ration applicable to soils with less than 35% clay.

[c] Hand magnet.

[d] Higher known value.

small and faint, the concerned diagnostic horizon being chiefly characterized by having no less than common and distinct clayskins associated with moderate to strong subangular and even angular blocky structure.

3. Distinction from low clay activity Plinthosols—These soils have either: (a) a plinthic horizon[3] or its petric succedent horizon sequent to any A, AB, E, or EB horizon; (b) a plinthic horizon or its petric succedent horizon occurring within 60 cm of the soil surface, being preceded by a B horizon containing not enough plinthite or petroplinthite for plinthic or pertroplinthic, otherwise this preceding horizon shows many mottles tending to or of reduction colors in a red to yellow rather pale matrix, or vice-versa; (c) a plinthic horizon or its petric succedent horizon within 210 cm of the soil surface, being preceded till the base of the A by an E horizon or by a quite palid horizon having color tending to or of reduction, otherwise mottled with such colors.
4. Distinction from low activity clay Cambisols—These soils have in sequence to an A or AB a diagnostic incipient B horizon differing from a latosolic B primarily by meeting one or more of these requirements: (a) contain in the fraction < 0.05 mm, as reported to the fine-earth fraction, ≥ 4 percent easily weatherable primary minerals or ≥ 6 percent muscovite; (b) have meaningful proportions of clay mineral less resistant to weathering than kaolinite; (c) have either 5 percent or more by volume of semiweathered rock fragments with altered or nonaltered easily weatherable constituents, or have 5 percent or more of rock structure remains or saprolitic material.
5. Distinction from Red-Yellow Quartz Sands—The bare difference lays in the higher clay content by definition of Latosols, ordinarily > 15 percent.
6. Distinction from low activity Gleysols—The presence of a diagnostic gley horizon within 50 cm of the soil surface answers for the difference from Latosols.

Dissonance in Relation to *Soil Taxonomy*

From a comparative standpoint, notice that several attributes of Latosols and Oxisols are identical or similar, a conformance due to equivalence of some requirements set for both overall classes of soils, but equality does not happen, even when the highest categorical rank is considered.

Of relevance is the discordance of the Brazilian classification which is centered toward latosolic B and, further, the types of A horizons, in contradistinction to *Soil Taxonomy's* accounting for oxic horizons and types of epipedons—therefore their overlap.

However, differences prevailing chiefly arise from distinctions in criteria pertaining to latosolic B and oxic B horizons, as described in the following remarks.

1. Relevant hydromorphic conditions exclude latosolic B criteria—considered restrictive of one or more of the attributes recognized as typical of Latosols, implying in the nature of latosolic B horizon, namely residual concentration of sesquioxides being counteracted by iron oxides reduction and liability to migration and eventual removal; counteraction to desilication of soil material; high silt-clay ratio and low proportion of weatherable primary minerals since parent material in the case in view is mostly of aggraded nature.
2. Relevant plinthite either following the A horizon or sequent to intervening deferrified horizon(s) excluded from latosolic B, being recognized as characteristic of plinthic horizon.
3. Minimum thickness of 50 cm for latosolic B horizon versus 30 cm for oxic horizon.
4. Easily weatherable primary minerals in the sands, as reported to the fine-earth fraction, < 4 percent or < 6 percent of muscovite as criteria for latosolic B versus < 3 percent in the 20 to 200 micra fraction for oxic horizon.
5. Silt-clay ratio admitted as criteria for latosolic B and not for oxic horizon.
6. Divergent limits for CEC as explained in Table 2. Apart from the causes mentioned, standing divergences developed from the second higher categorical level, and necessarily down following classes. Naturally, they are the expression of discrepant differentia applied to class formation, that is moisture regime and humic character are taken into account for Oxisols, whereas attributes reflecting the essence of inorganic constitution of the soil material are applied to Latosols.

Thus, comparisons of Latosol and Oxisol descendant classes led to difficulties and confusing correlations at the second taxonomic level, the results being demonstrative of divergences, as shown in Table 3.

Future Perspective

Compelled by the need to overcome enduring deficiencies, aggravated by the amount of information gained through soil surveys, and induced by changes in concepts envisioned for soil groupings, the soil classification frame has been subjected to a critical reappraisal since 1978, which has led to decisions favoring reformulation and achievement of a formal framing of soil classification of the country, a process under development.

The fundamental thought behind the classification of Latosols has persisted from the present framing, as detailed in the foregoing exposition.

Present trends towards a reformulated classification of Latosols can be illustrated by the trial delineation which follows.

CATEGORY I. CLASS 8—SOILS WITH LATOSOLIC B UNDERLAYING A OR AB HORIZONS

Base: Well-advanced evolution, intense weathering of constituents, diffuse residual concentration of sesquioxides and/or resistant silicate clay minerals, negligible argilluviation, impoverishment, ferrolysis, gleyzation, or plinthitization.

Criteria: Development of latosolic B underlying an AB or any kind of A horizon but histic, allied to small clay increase from A to B, if any.

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[3] ≥ 15 cm thick and ≥ 15 percent by volume plinthite.

Table 2. Comparison of CEC Limits as Adopted for Soil Classification in Brazil and in *Soil Taxonomy*

Distinction intended in Brazilian classification	Brazilian SNLCS CEC Values: Organic carbon contribution subtracted	Brazilian SNLCS CEC Values: No subtraction	NSSL-SCS USDA CEC values (no subtraction)	Distinction intended in *Soil Taxonomy*
	(meq per 100 grams of clay)			
High activity/low activity clay soils	24	27	42	Nihil
Limit latosolic B horizon	13	16	24	Limit oxic subgroups
Nihil	8	10	16	Limit oxic horizon
Limit typic latosolic B horizon, i.e., highly weathered types	6.5	8.5	14	Nihil

CATEGORY II. CLASSES

8.1 Very low content of iron (< 7 percent) and aluminum oxides, virtually kaolinitic (xanthic).

8.2 "Aluminous" soils, medium to high content of iron oxides, and either chiefly kaolinitic or sesquioxidic (helvic).

8.3 Medium to low content of iron oxides (< 18 percent) and either chiefly kaolinitic or sesquioxidic (xanthic or rhodic).

8.4 High content of iron oxides (> 18 percent) and either chiefly kaolinitic or sesquioxidic (mostly rhodic).

8.5 Very high content of iron oxides (≥ 36 percent) and virtually devoid of kaolinite or other silicate clay minerals (rhodic).

CATEGORY III. (PARTITION OF CLASS 8.3)

	Organic content	Base saturation	Main mineralogy
8.3.1	High	Dissaturated	Kaolinitic rather than sesquioxidic
8.3.2	Same	Same	Sesquioxidic rather than kaolinitic
8.3.3	Medium to low	Same	Kaolinitic rather than sesquioxidic
8.3.4	Same	Slightly unsaturated	Same
8.3.5	Same	Nearly saturated	Same
8.3.6	Same	Dissaturated	Sesquioxidic rather than kaolinitic

CATEGORY IV. (PARTITION OF CLASS 8.3.6)

8.3.6.1 Typic (Pro henatitic, namely rhodic)
8.3.6.2 Pro goethitic (nonrhodic)
8.3.6.3 Intergrades with class 8.3.4 (cambic)
8.3.6.4 Intergrades with class 12 (gleyic)

As shown, fundamental similitude is held with the present-day classification of Latosols. The needed operational possibilities, to provide feasible distinction of acric from nonacric Latosols, remain a major shortcoming.

The framing of a formal proposal for the classification of Latosols is not firmly set. The whole reformulation of the soil classification system designed for Brazil is in progress, and achieving a prototype for experimental operation may be possible by 1988.

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Table 3. Approximate Equivalent Between the Brazilian Classification of Latosols and Oxisols in *Soil Taxonomy* (Soil Survey Staff 1975)

Present Brazilian classification	*Soil Taxonomy*	
Major classes of Latosols	Great groups mainly related[1]	Great groups secondarily related[1]
Ferriferous Latosols	Acrohumox; Acrorthox	
Dusky Red Latosols	Acr, Hapl, Eutr Orthox & Ustox; Acrohumox	Umbriorthox; Haplohumox; Dystropepts; Dystrochrepts
Dark Red Latosols	Acr, Hapl, Umbri Orthox; Acr, Hapl, Eutr Ustox; Acrohumox	Umbriorthox; Eutrorthox; Haplohumox; Dystrochrepts Dystr, Ust Tropepts
Red-Yellow Latosols	Acr, Hapl, Umbri Orthox; Acr, Hapl Ustox; Acrohumox	Sombriorthox; Hapl, Sombri Humox; Eutrustox; Torrox; Dystr, Ust Tropepts
Yellow Latosols	Hapl, Acr, Orthox & Ustox	Hapl, Acr Humox; Torrox; Dystr, Ust Tropepts
Brown Latosols	Hapl, Acr Humox; Acr, Umbri Orthox	Sombrihumox; Sombriorthox Dystr, Humi Ochrepts
Latosols *Una* variation	Acr, Sombri Orthox; Acrohumox	Acr, Sombri Ustox; Sombri humox; Dystropepts

[1] Always *pro parte*

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