

# Simplified WRB Diagnostics for the Nanjing Contest 2026

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This document provides simplified criteria for some diagnostic horizons, diagnostic properties and diagnostic materials of WRB, only for use in the Soil Judging Contest. Whenever you do a professional soil classification, you must use the WRB Manual: [https://wrb.isric.org/files/WRB\\_fourth\\_edition\\_2022-12-18\\_errata\\_correction\\_2024-09-24.pdf](https://wrb.isric.org/files/WRB_fourth_edition_2022-12-18_errata_correction_2024-09-24.pdf).

In most cases, you will not have the possibility to detect the dry colour. We therefore assume:

1. Dry value is 1 color chip higher than the moist value
2. Dry chroma and moist chroma are the same.

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# Diagnostic horizons

## 1 Anthraquic horizon

### General description

An anthraquic horizon (from Greek *anthropos*, human being, and Latin *aqua*, water) is a surface horizon that results from wet-field cultivation and comprises a *puddled layer* and a *plough pan*.

### Simplified diagnostic criteria

An anthraquic horizon is a surface horizon consisting of *mineral material* and has:

1. a puddled layer with *gleyc properties*;  
*and*
2. a plough pan underlying the puddled layer, with all of the following:
  - a. one or both of the following:
    - i. a platy structure in  $\geq 25\%$  of its volume; **or**
    - ii. a massive structure in  $\geq 25\%$  of its volume;  
*and*
  - b. a bulk density higher by  $\geq 10\%$  (relative) than that of the puddled layer;  
*and*
  - c. *gleyc properties*;  
*and*
3. a thickness of  $\geq 15$  cm.

## 2 Argic horizon

### General description

An argic horizon (from Latin *argilla*, white clay) is a subsurface horizon with clay illuviation.

### Simplified diagnostic criteria

1. texture class loamy sand or finer and  $\geq 8\%$  clay;  
*and*
2. one or both of the following:
  - a. if an overlying coarser-textured layer exists (no *lithic discontinuity* in between), the following differences in clay content apply:

<i>overlying horizon</i>	<i>argic horizon</i>
< 15 % clay	at least 6 % more clay (absolute)
15 – 50 % clay	at least 1.4 times more clay
$\geq 50\%$ clay	at least 20 % more clay (absolute)

*or*

2. b. has evidence of illuvial clay in one or more of the following forms:
  - i. clay bridges connecting  $\geq 15\%$  of the sand grains; **or**
  - ii. clay coatings covering  $\geq 15\%$  of the surfaces of soil aggregates, coarse fragments and/or biopore walls;
- and*
3. has a thickness of:
  - a.  $\geq 7.5$  cm if the argic horizon has a texture class of sandy loam or finer; **or**

- b.  $\geq 15$  cm.

### 3 Cambic horizon

#### General description

A cambic horizon (from Latin *cambire*, to change) is a subsurface horizon showing evidence of soil formation that ranges from weak to relatively strong.

#### Simplified diagnostic criteria

1. texture class: clay, silt, loam or fine sand (not: coarse sand, medium sand);  
**and**
2. soil aggregate structure in  $\geq 50\%$  of the fine earth (by volume);  
**and**
3. evidence of soil formation by one or more of the following:
  - a. compared to the directly underlying layer (no *lithic discontinuity* in between) one or more of the following:
    - i. redder colour (redder Munsell hue); **or**
    - ii. more intensive colour (higher Munsell chroma); **or**
    - iii. higher clay content;  
**or**
  - b. compared to an overlying mineral layer ( $\geq 5$  cm thick, no *lithic discontinuity* in between) one or more of the following:
    - i. lighter colour (higher Munsell value); **or**
    - ii. redder colour (redder Munsell hue); **or**
    - iii. more intensive colour (higher Munsell chroma);  
**or**
  - c. compared to the directly underlying layer: evidence of removal of carbonates or gypsum by one or both of the following:
    - i. less carbonates or gypsum than this underlaying layer (no *lithic discontinuity* in between); **or**
    - ii. *protocalcic properties* or *protogypsic properties* in this underlaying layer but not in the cambic horizon;  
**or**
  - d. evidence of Fe oxide formation by all of the following:
    - i.  $Fe_{dith} \geq 0.1\%$ ; **and**
    - ii. ratio between  $Fe_{ox}$  and  $Fe_{dith} \geq 0.1$ ; **and**
    - iii. Munsell colour chroma  $> 3$ ;**and**
4. does not form part of diagnostic horizons or properties that indicate a more advanced soil formation and does not form part of a plough layer;  
**and**
5. thickness  $\geq 15$  cm.

### 4 Hydragric horizon

#### General description

A hydragric horizon (from Greek *hydor*, water, and Latin *ager*, field) is a subsurface horizon that results from wet-field cultivation.

### **Simplified diagnostic criteria**

A hydric horizon consists of *mineral material* and:

1. is overlain by an *anthraquic horizon*;  
**and**
2. consists of one or more subhorizons and each of them has one or more of the following:
  - a. *stagnic properties*;  
**or**
  - b. *gleyc properties*;  
**or**
  - c.  $\text{Fe}_{\text{dith}} \geq 1.5$  times and/or  $\text{Mn}_{\text{dith}} \geq 3$  times that of the weighted average of the puddled layer of the overlying *anthraquic horizon*;  
**and**
3. has a thickness of  $\geq 10$  cm.

## **5 Mollic horizon**

### **General description**

A mollic horizon (from Latin *mollis*, soft) is a relatively thick, dark-coloured surface horizon with a high base saturation and a moderate to high content of organic matter.

### **Simplified diagnostic criteria**

A mollic horizon is a surface horizon consisting of *mineral material* and has:

1. single or in combination, in  $\geq 50\%$  (by volume):
  - a. soil aggregate structure with an average aggregate size of  $\leq 10$  cm; **or**
  - b. cloddy structure or other structural elements created by agricultural practices;  
**and**
2.  $\geq 0.6\%$  *soil organic carbon*;  
**and**
3. in  $\geq 90\%$  of the exposed area of the entire horizon or of the subhorizons below any plough layer, a Munsell colour value of  $\leq 3$  moist, and  $\leq 5$  dry, and a chroma of  $\leq 3$  moist;  
**and**
4. a base saturation (by  $1\text{ M NH}_4\text{OAc}$ , pH 7) of  $\geq 50\%$  on a weighted average;  
**and**
5. a thickness of one of the following:
  - a.  $\geq 10$  cm if directly overlying *continuous rock*, *technic hard material* or a *cryic*, *petrocalcic*, *petroduric*, *petrogypsic* or *petroplinthic horizon*; **or**
  - b.  $\geq 20$  cm.

## **6 Panpaic horizon**

### **General description**

A panpaic horizon (from Quechua *p'anpay*, to bury) is a buried mineral surface horizon with a significant amount of organic matter formed before having been buried.

### **Diagnostic criteria**

A panpaic horizon is a buried surface horizon consisting of *mineral material* and has:

1.  $\geq 0.2\%$  *soil organic carbon*; **and**

2. a content of *soil organic carbon*  $\geq 25\%$  (relative) and  $\geq 0.2\%$  (absolute) higher than in the overlying layer; **and**
3. a *lithic discontinuity* at its upper limit; **and**
4. a thickness of  $\geq 5$  cm.

## 7 Protovertic horizon

### General description

A protovertic horizon (from Greek *proton*, first, and Latin *vertere*, to turn) has swelling and shrinking clay minerals.

### Simplified diagnostic criteria

A protovertic horizon consists of *mineral material* and has:

1.  $\geq 30\%$  clay;  
**and**
2. one or more of the following:
  - a. wedge-shaped soil aggregates in  $\geq 10\%$  (by volume); **or**
  - b. slickensides on  $\geq 5\%$  of the surfaces of soil aggregates; **or**
  - c. *shrink-swell cracks*;  
**and**
3. a thickness of  $\geq 15$  cm.

## 8 Umbric horizon

### General description

An umbric horizon (from Latin *umbra*, shade) is a relatively thick, dark-coloured surface horizon with a low base saturation and a moderate to high content of organic matter.

### Simplified diagnostic criteria

An umbric horizon is a surface horizon consisting of *mineral material* and has:

1. single or in combination, in  $\geq 50\%$  (by volume):
  - a. soil aggregate structure with an average aggregate size of  $\leq 10$  cm; **or**
  - b. cloddy structure or other structural elements created by agricultural practices;  
**and**
2.  $\geq 0.6\%$  *soil organic carbon*;  
**and**
3. in  $\geq 90\%$  of the exposed area of the entire horizon or of the subhorizons below any plough layer, a Munsell colour value of  $\leq 3$  moist, and  $\leq 5$  dry, and a chroma of  $\leq 3$  moist;  
**and**
4. a base saturation (by 1 M NH<sub>4</sub>OAc, pH 7) of  $< 50\%$  on a weighted average;  
**and**
5. a thickness of one of the following:
  - a.  $\geq 10$  cm if directly overlying *continuous rock*, *technic hard material* or a *cryic*, *petroduric* or *petroplinthic horizon*; **or**
  - b.  $\geq 20$  cm.

## 9 Vertic horizon

### General description

A vertic horizon (from Latin *vertere*, to turn) is a clay-rich subsurface horizon that, as a result of shrinking and swelling, has slickensides and/or wedge-shaped soil aggregates.

### Diagnostic criteria

A vertic horizon consists of *mineral material* and has:

1.  $\geq 30\%$  clay;  
**and**
2. one or both of the following:
  - a. in  $\geq 20\%$  (by volume), wedge-shaped soil aggregates with a longitudinal axis tilted between  $\geq 10^\circ$  and  $\leq 60^\circ$  from the horizontal; **or**
  - b. slickensides on  $\geq 10\%$  of the surfaces of soil aggregates;  
**and**
3. *shrink-swell cracks*;  
**and**
4. a thickness of  $\geq 25$  cm.

## Diagnostic properties

## 10 Abrupt textural difference

### General description

An abrupt textural difference (from Latin *abruptus*, broken away) is a very sharp increase in clay content within a limited depth range.

### Diagnostic criteria

An abrupt textural difference refers to two superimposed layers consisting of *mineral material* with all of the following:

1. the underlying layer has all of the following:
  - a.  $\geq 15\%$  clay; **and**
  - b. a thickness of  $\geq 7.5$  cm;  
**and**
2. the underlying layer starts  $\geq 10$  cm from the mineral soil surface;  
**and**
3. the underlying layer has, compared to the overlying layer:
  - a. at least twice as much clay if the overlying layer has  $< 20\%$  clay; **or**
  - b.  $\geq 20\%$  (absolute) more clay if the overlying layer has  $\geq 20\%$  clay;  
**and**
4. if the limit between the two layers is not even, the depth of the abrupt textural difference is where the underlying layer reaches  $\geq 50\%$  of the total volume;  
**and**
5. a transitional layer, if present, has a thickness of  $\leq 2$  cm.

## 11 Continuous rock

### Diagnostic criteria

Continuous rock (from Latin *continuare*, to continue) is consolidated material, exclusive of cemented pedogenic horizons such as *limonic*, *petrocalcic*, *petroduric*, *petrogypsic*, *petroplinthic* and *spodic horizons*. Continuous rock is sufficiently consolidated to remain intact when an air-dried specimen, 25–30 mm on one side, is submerged in water for 1 hour. The material is considered continuous only if cracks occupy < 10% (by volume, related to the whole soil) of the continuous rock, with no significant displacement of the rock having taken place.

## 12 Gleyic properties

### General description

Gleyic properties (from Russian folk name *gley*, wet bluish clay) develop in layers that are saturated with groundwater (or were saturated in the past, if now drained) for a period long enough to allow *reducing conditions* to occur.

### Diagnostic criteria

Gleyic properties refer to *mineral material* and comprise one of the following:

1. a layer with  $\geq 95\%$  (by exposed area) reductimorphic features that have the following Munsell colours, moist:
  - a. a hue of N, 10Y, GY, G, BG, B or PB; **or**
  - b. a hue of 2.5Y or 5Y and a chroma of  $\leq 2$ ;  
**or**
2. a layer with  $> 5\%$  (by exposed area, related to the fine earth plus oximorphic features of any size and any cementation class) oximorphic features that:
  - a. are predominantly on biopore walls and, if soil aggregates are present, predominantly on or adjacent to aggregate surfaces; **and**
  - b. have a Munsell colour hue  $\geq 2.5$  units redder and a chroma  $\geq 1$  unit higher, moist, than the surrounding material or than the matrix of the directly underlying layer;  
**or**
3. a combination of two layers: a layer fulfilling diagnostic criterion 2 and a directly underlying layer fulfilling diagnostic criterion 1.

## 13 Lithic discontinuity

### General description

Lithic discontinuities (from Greek *lithos*, stone, and Latin *continuare*, to continue) represent significant differences in parent material within a soil. A lithic discontinuity can also denote different times of deposition. The different strata may have the same or a different mineralogy.

### Simplified diagnostic criteria

When comparing two directly superimposed layers consisting of *mineral material*, a lithic discontinuity requires one or more of the following:

1. an abrupt difference in particle-size distribution that is not solely associated with a change in clay content resulting from soil formation;  
**or**
2. the layers have coarse fragments with different lithology;  
**or**

3. a layer containing coarse fragments without weathering rinds overlying a layer containing coarse fragments with weathering rinds;  
**or**
4. a layer with angular coarse fragments overlying or underlying a layer with rounded coarse fragments;  
**or**
5. an overlying layer that has  $\geq 10\%$  (absolute, by volume, related to the whole soil) more coarse fragments than the underlying layer, unless the difference is created by animal activity;  
**or**
6. a lower amount of coarse fragments in the overlying layer that cannot be explained by advanced weathering in the overlying layer;  
**or**
7. abrupt differences in colour not resulting from soil formation.

## 14 Protocalcic properties

### General description

Protocalcic properties (from Greek *proto*, first, and Latin *calx*, lime) refer to carbonates that are derived from the soil solution and precipitated in the soil. They do not belong to the soil parent material. They occur across the soil structure or fabric. These carbonates are called secondary carbonates.

### Diagnostic criteria

Protocalcic properties refer to concentrations of secondary carbonates, visible when moist, that show one or more of the following:

1. occupy  $\geq 5\%$  of the exposed area (related to the fine earth plus concentrations of secondary carbonates of any size and any cementation class) with masses, nodules, concretions or filaments; **or**
2. cover  $\geq 10\%$  of the surfaces of soil aggregates or biopore walls; **or**
3. cover  $\geq 10\%$  of the underside surfaces of coarse fragments or of remnants of a cemented horizon.

## 15 Reducing conditions

### Simplified diagnostic criteria

Reducing conditions (from Latin *reducere*, to draw back) show one or more of the following:

1. a negative logarithm of the hydrogen partial pressure ( $rH$ , calculated as  $Eh \cdot 29^{-1} + 2 \cdot pH$ ) of  $< 20$ ; **or**
2. the presence of free  $Fe^{2+}$ , as shown on a freshly broken and smoothed surface of a field-wet soil by the appearance of a strong red colour after wetting it with 0.2%  $\alpha,\alpha'$ -dipyridyl dissolved in 1 N ammonium acetate ( $NH_4OAc$ ), pH 7

## 16 Shrink-swell cracks

### General description

Shrink-swell cracks open and close due to shrinking and swelling of clay minerals with changing water content of the soil. They may be evident only when the soil is dry. They control the infiltration and percolation of water, even if they are filled with material from the surface.

### Diagnostic criteria

Shrink-swell cracks refer to *mineral material* and

1. open and close with changing water content of the soil; **and**
2. are  $\geq 0.5$  cm wide, when the soil is dry, with or without infillings of material from the surface.

## 17 Stagnic properties

### General description

Stagnic properties (from Latin *stagnare*, to flood) form in layers that are, at least temporarily, saturated with stagnant water (or were saturated in the past, if now drained) for a period long enough to allow *reducing conditions* to occur.

### Simplified diagnostic criteria

Stagnic properties refer to *mineral material* and shows one or more of the following:

1. compare reductimorphic features and matrix colour:
  - a. location of reductimorphic features: outer parts of the aggregates and around biopores; **and**
  - b. colour of reductimorphic features: higher value and lower chroma;  
**or**
2. compare oximorphic features and matrix colour:
  - a. location of oximorphic features: inside the aggregates; **and**
  - b. colour of oximorphic features: black or redder hue and higher chroma;  
**or**
3. compare oximorphic features and reductimorphic features:
  - a. location of reductimorphic features: outer parts of the aggregates and around biopores; **and**
  - b. location of oximorphic features: inside the aggregates; **and**
  - c. colour of oximorphic features:
    - i. black; **or**
    - ii. strongly redder hue (5 units); **or**
    - iii. strongly higher chroma (4 units); **or**
    - iv. redder hue (2.5 units) and higher chroma (2 units); **or**
    - v. redder hue (2.5 units), lower value (1 unit), higher chroma (1 unit);  
**or**
4. *claric material* (considered as reductimorphic feature)  
above an *abrupt textural difference* or above a very dense layer ( $\geq 1.5 \text{ kg dm}^{-3}$ );  
**or**
5. *claric material* (considered as reductimorphic feature)  
above a layer fulfilling the diagnostic criteria 1, 2 or 3.

## Diagnostic materials

## 18 Calcaric material

### General description

Calcaric material (from Latin *calcarius*, containing lime) refers to material that contains  $\geq 2\%$  calcium carbonate equivalent. The carbonates are at least partially inherited from the parent material (primary carbonates).

### Diagnostic criteria

Calcaric material is at least moderately calcareous and shows visible effervescence with 1 M HCl throughout the fine earth.

## 19 Clanic material

### General description

Clanic material (from Latin *clarus*, bright) is light-coloured fine earth.

### Diagnostic criteria

Is *mineral material* and

1. has in  $\geq 90\%$  of its exposed area a Munsell colour, dry, with one or both of the following:
  - a. a value of  $\geq 7$  and a chroma of  $\leq 3$ ; **or**
  - b. a value of  $\geq 5$  and a chroma of  $\leq 2$ ;

**and**
2. has in  $\geq 90\%$  of its exposed area a Munsell colour, moist, with one or more of the following:
  - a. a value of  $\geq 6$  and a chroma of  $\leq 4$ ;
  - or**
  - b. a value of  $\geq 5$  and a chroma of  $\leq 3$ ;
  - or**
  - c. a value of  $\geq 4$  and a chroma of  $\leq 2$ ;
  - or**
  - d. all of the following:
    - i. a hue of 5YR or redder; **and**
    - ii. a value of  $\geq 4$  and a chroma of  $\leq 3$ ; **and**

$\geq 25\%$  of the sand and coarse silt grains are uncoated

## 20 Solimovic material

### General description

Solimovic material (from Latin *solum*, soil, and *movere*, to move) is a heterogeneous mixture of material that has moved downslope, suspended in water. It is dominated by material that underwent soil formation at its original place, e.g. organic matter accumulation or the formation of Fe oxides. It has been transported as a result of erosional wash, and the transport may have been accelerated by land-use practices.

### Diagnostic criteria

Solimovic material is *mineral material* and

1. is found on slopes, footslopes, toeslopes, fans, in depressions, above barriers, along gullies or similar relief positions, originating from upslope positions where it was subject to diffuse erosion;

**and**
2. is not of fluvial, lacustrine, marine or mass movement origin;

**and**
3. one or more of the following:
  - a. if burying a mineral soil, it has a lower bulk density than the uppermost layer of the buried soil; **or**
  - b. has  $\geq 0.6\%$  *soil organic carbon*; **or**
  - c. has a Munsell colour chroma of  $\geq 3$ , moist; **or**
  - d. contains *artefacts* and/or black carbon of any size; **or**
  - e. has  $\geq 100 \text{ mg kg}^{-1}$  P in the Mehlich-3 extract;

**and**
4. does not form part of a diagnostic horizon other than a *cambic*, *chernic*, *mollic* or *umbric horizon*.