

SOLONETZIC SOILS: THEIR NATURE AND DISTRIBUTION IN SASKATCHEWAN

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Nature of Solonetzic Soils

Solonetzic soils are defined as those soils that have a solonetzic B horizon (Bn or Bnt). This horizon has columnar or prismatic structure, is hard to very hard when dry, and has a ratio of exchangeable Ca to Na of 10 or less (Canada Soil Survey Committee, 1978). The typical prismatic or columnar macrostructure, breaks to hard to very hard blocky peds with dark coatings that often have a waxy appearance, and swell to a sticky mass with very low permeability when wet.

Solonetzic soils occur on saline parent materials in various areas of the semiarid to subhumid Interior Plains of North America, most often in association with Chernozemic soils and to a lesser extent with Luvisolic and Gleysolic soils. Most occur under a natural vegetative cover of grasses and forbs. These soils are thought to have developed in parent materials that were more or less uniformly salinized with salts high in sodium. This is probably true in areas where the landscape is dominated by Solonetzic soils, but many acres of Solonetzic soils occur in association with Chernozemic soils. In these areas the Solonetzic soils normally occur in lower landscape positions; probably the result of concentration of sodium salts in lower landscape positions by water movement through the soil.

Three processes are involved in the formation of Solonetzic soils; salinization, desalinization and solinization (Heck, 1989). The process of salinization has been mentioned above. After salinization a change in the hydrologic cycle must occur that will favour desalinization. Such a change may be the result of increased precipitation, a change in soil drainage, or both. Desalinization involves the downward leaching of sodium salts by percolating water resulting in the dispersion of soil colloids and their subsequent translocation downward and deposition in the B horizon. Further leaching results in depletion of alkali cations in the A horizon, which becomes acidic, and a platy Ae horizon usually develops. Solonization is the process whereby sodium is replaced on the exchange complex. Structural breakdown of the upper part of the B horizon occurs as exchangeable sodium is replaced and leached downward. Complete destruction of the solonetzic B horizon is the most advanced stage of solonization. The rate of evolution through the stages of development depends on the salt content and hydraulic conductivity of the parent material, as well as the climate. Three kinds of Solonetzic soils are recognized, which essentially represent these various stages of leaching or translocation of materials within the soil profile.

These soils have been classified as Solonetz, Solodized Solonetz and Solod and are briefly described below. Soils that have Solonetzic morphology, but do not meet the chemical criteria for Solonetzic soils are classified as Solonetzic Chernozems.

Solonetz Soils - are Solonetzic soils with the least morphological development (Fig. 1). They are soils that are characterized by an Ah or Ap horizon underlain by a Bn or Bnt horizon, which is, in turn, underlain by a Cks horizon. The Bn or Bnt horizon has a prismatic or weak columnar primary structure that breaks to a strong, subangular blocky and angular blocky secondary structure with a hard to very hard consistence when dry. Ped surfaces within the Bn or Bnt horizons often have shiny or waxy looking surfaces.

Solonetz

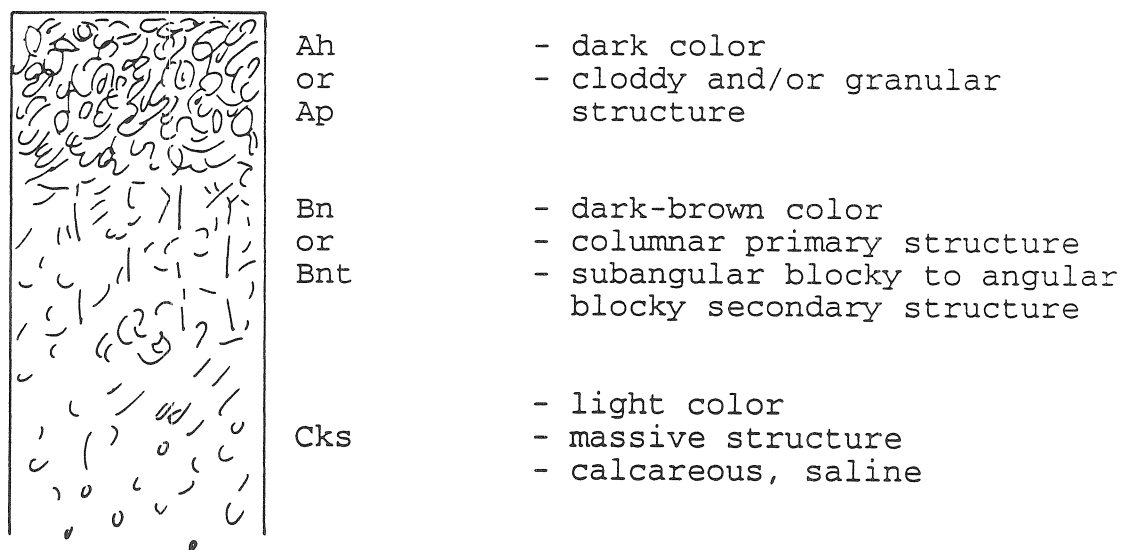


Figure 1. Sketch of Solonetz soil showing horizon sequence.

Solodized Solonetz Soils - are Solonetzic soils that have the strongest morphological development (Fig. 2). They are characterized by an Ah or Ap horizon underlain by a light-colored, Ae horizon with platy structure. The Ae is underlain by a Bnt horizon with strong round-top columnar, primary structure and strong, angular blocky to subangular blocky secondary structure with a very hard to extremely hard consistence when dry (Fig. 4). Ped surfaces are very darkly stained and usually have a waxy or shiny appearance. The Bnt horizon is, in turn, underlain by a Cks horizon. These are the least productive of the Solonetzic soils and are the Solonetzic soils most often considered for deep-ripping or deep plowing treatments.

Solodized Solonetz

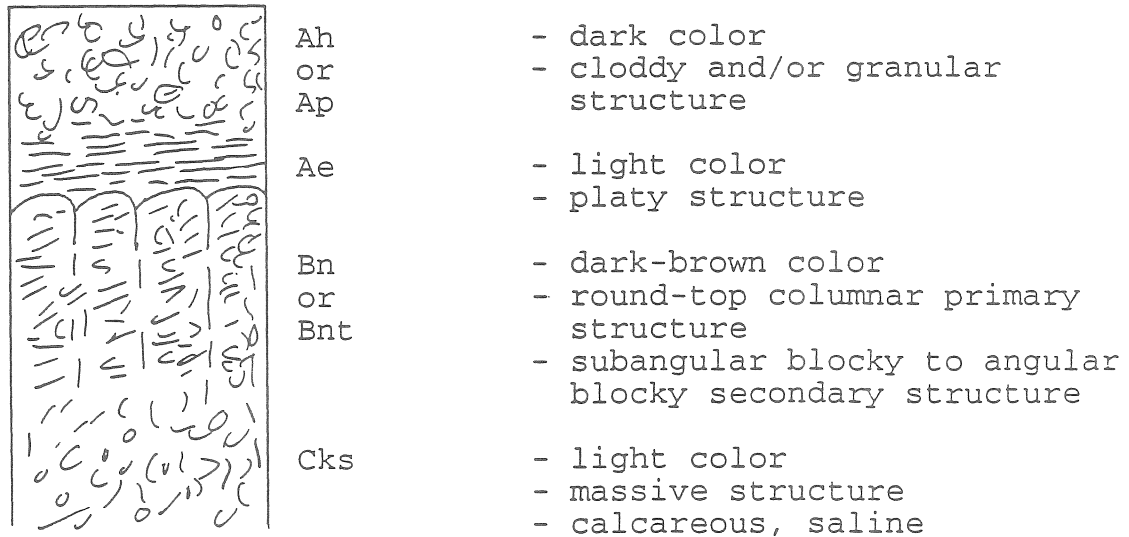


Figure 2. Sketch of Solodized Solonetz soil showing horizon sequence.

Solod Soils - are the Solonetzic soils that have undergone the highest degree of leaching and translocation of materials and are considered to be strongly leached soils (Fig. 3). These are soils that have reached an advanced stage of Solonization. They are characterized by an Ah or Ap horizon underlain by a relatively deep, light-colored Ae horizon. The Ae horizon is, in turn, underlain by an AB horizon, which is a former Bnt horizon that is undergoing leaching with the subsequent removal of sodium from the exchange complex and the downward movement of clay. The AB horizon is underlain by a relatively thin Bnt horizon. The Bnt horizon has the columnar primary structure, with strong angular blocky to subangular blocky secondary structure, characteristic of the B horizons of Solonetzic soils, but does not have the round-top columnar structure characteristic of Solodized Solonetz soils. The Bnt horizon is, in turn, underlain by a Cks or Ck horizon. As a result of the depletion of salts and the breakdown of the dense, impervious B horizon, these are usually more productive soils than the Solodized Solonetz.

Solod

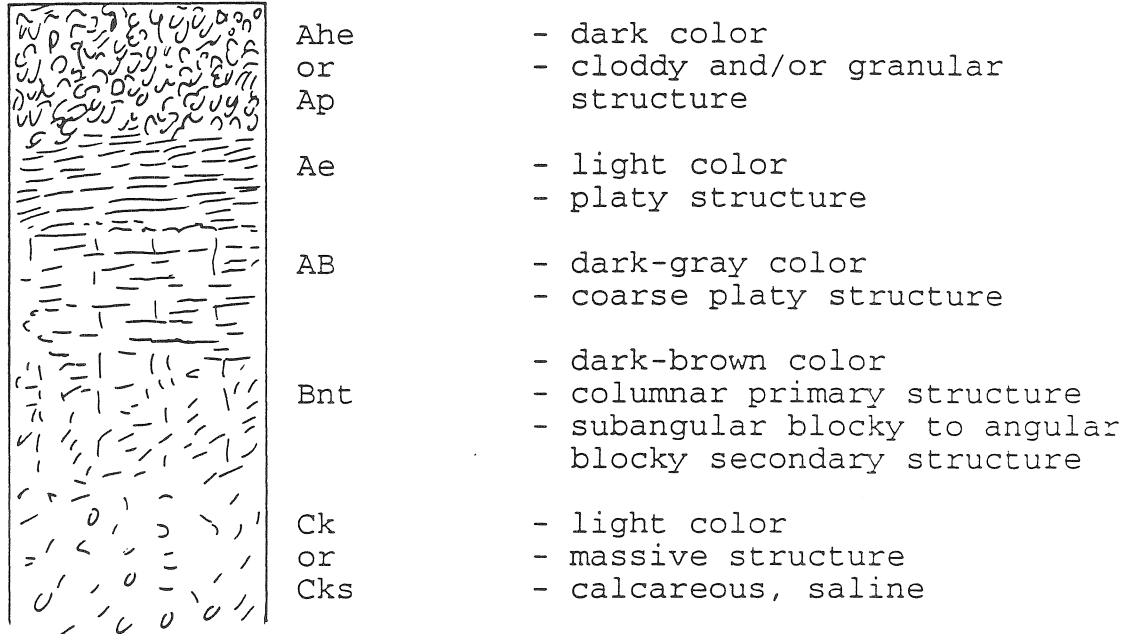


Figure 3. Sketch of Solod soil showing horizon sequence.

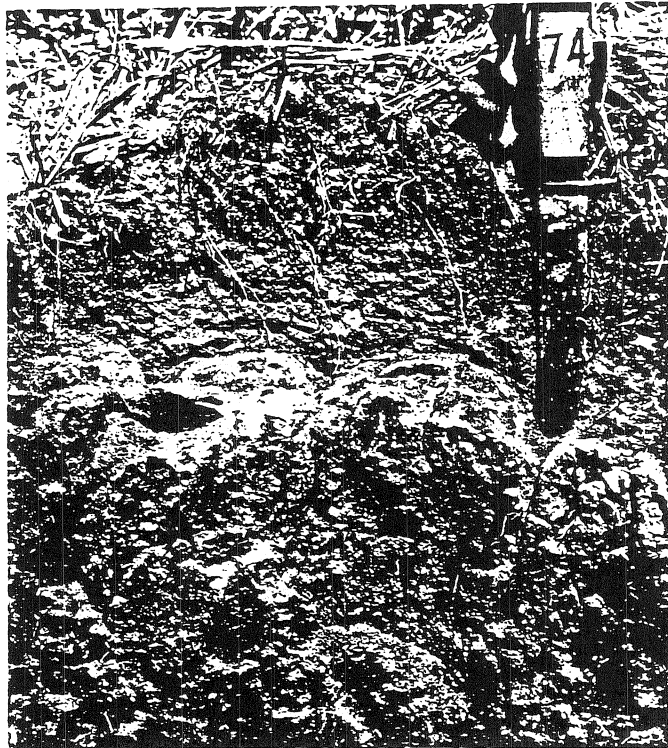


Figure 4. Round-top columns of a Solodized Solonetz soil.

EXTENT OF SOLONETZIC SOILS

Solonetzic soils, in Saskatchewan, occur on a wide variety of parent materials that include glacial till and water-laid sediments ranging in texture from sand to clay. They cover an area of approximately 4.5 million acres (2.8 million hectares), primarily in the Brown and Dark Brown soil zones (Table 1).

Table 1. Extent of Solonetzic Soils in the Agricultural Area of Saskatchewan.

Zone	Acres	Hectares	Percent of Total
Brown	1,646,035	666 127	2.35
Dark Brown	1,913,052	774 185	2.73
Black	765,601	309 828	1.09
Gray	167,760	67 890	0.23
Total	4,492,448	1 818 030	6.40

In the Brown soil zone the major Solonetzic soil associations that occur are: Echo, Flaxcombe, Kindersley and Robsart. Gilroy, Kelstern and Kettlehut occur to a much lesser extent. In the Dark Brown soil zone, Brooking, Estevan, Hanley, Rosemae, Trossachs, Tuxford and Wingello are the main soil associations. The North Portal soil association occurs to a lesser extent. In the Black soil zone, Onion Lake, Waseca and Meadow Lake are the main soil associations, with minor occurrences of Speers. In the Gray soil zone, Arborfield is the main soil association. The extent of each of the major soil associations is listed in Tables 2 to 5.

Table 2. Extent of Solonetzic soils in the Brown Soil Zone.

Soil Association	Acres	Hectares	Percent of Zone
Echo (Ec)	823,088	333 092	5.31
Flaxcombe (Fc)	34,303	13 882	0.22
Kindersley (Kd)	186,500	75 473	1.20
Robsart (Ro)	602,144	243 679	3.88
Total	1,646,035	666 426	10.61

Others: Gilroy (Gy)
 Kelstern (Kn)
 Kettlehut (Kh)

Table 3. Extent of Solonetzic soils in the Dark Brown Soil Zone.

Soil Association	Acres	Hectares	Percent of Zone
Brooking (Bk)	29,472	11 927	0.16
Estevan (Es)	708,656	286 783	3.93
Hanley (Hy)	61,608	24 932	0.34
Rosmae (Rm)	91,757	37 133	0.51
Trossachs (Tr)	731,004	295 827	4.05
Tuxford (Tu)	285,799	115 659	1.59
Wingello (Wg)	4,756	1 925	0.03
Total	1,913,052	774 186	10.61

Others: North Portal (No)

Table 4. Extent of Solonetzic soils in the Black Soil Zone.

Soil Association	Acres	Hectares	Percent of Zone
Onion Lake (On)	22,325	9 054	0.15
Waseca (Wa)	657,456	266 062	4.39
Meadow Lake (Md)	85,820	34 730	2.37
Total	765,601	309 846	6.91

Others: Speers

Table 5. Extent of Solonetzic soils in the Gray Soil Zone.

Soil Association	Acres	Hectares	Percent of Zone
Arborfield (Ar)	167,760	67 890	4.26
Total	167,760	67 890	4.26

Distribution of Solonetzic Soils

The distribution of Solonetzic soils throughout the agricultural area of Saskatchewan is shown in Fig. 5.

References

- Canada Soil Survey Committee, Subcommittee on Soil Classification. 1978. The Canadian System of Soil Classification. Can. Dept. of Agric. Publ. 1646. Supply and Services Canada, Ottawa, Ont. 164 pp.
- Heck, R.J. 1989. Properties and Genesis of Solonetzic Soils Formed on Lacustrine Deposits in Saskatchewan. Master of Science Thesis, University of Saskatchewan, Saskatoon, Sask. 206 pp.