AEOLIAN SEDIMENT. PSAMOSOLS AND/OR ARENOSOLS

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Abstract: *Aeolian processes, involving erosion, transportation and deposition of sediment by the wind, occur in a variety of environments, including beaches, semi-arid and arid regions, agricultural fields. Wind, blowing over dry sand, initiates movement in much the same way as water. The result is that sands moved by air tend to very well sorted and also well rounded. There are three modes of sediment transport by wind: creep or reptation, saltation, and suspension. Erosion by wind involves abrasion and deflation. Major dust source areas Tchad, the Aral Sea area, SE Iran, and the loess plateau of China. Aeolian deposits include sand seas and dune fields, deposit of silt and fine – grained material. Dunes are composed of moderately to well – sorted sands (63-1000µm) with a mean grain size in the range 160-300 µm. Most dune sands are composed of quartz, but may include significant quantities of feldspar. Major areas of sand seas lie in the tectonically desert regions of the Sahara, Arabian Peninsula, Australia, S. Africa and central Asia. Many Aeolian deposits are formed during the Quaternary Era, thus they have, been now soils. In SRTS 2012, Psammosol is the soil type developed from Aeolian sand, including soils that have a mollic, an umbric or an ochric A horizon, followed by parent materials of Aeolian sandy deposits ≥50 cm thick and have ≤12% clay. We have analysed and compared soil profiles from Banat region (Lovrin), Satu Mare (NW of Romania) – Nir river, and Oltenia region (Dăbuleni).*
Psammosols correlated in WRB-SR-1998 with Arenosols. Arenosols are a reference soils group with a texture that is coarser than sandy loam to a depth of least 100 cm from the surface and having less than 35 per cent of rock fragments. These soils occur on deep Aeolian, marine, lacustrine and alluvial sands. The total estimated extent is 900 million hectares. Because the modern Geology classified rocks using Latin terms (arena – sand, rudectus – stony, lutum – loamy, and argilla - clay), we consider that aspect important for our Latin language, and in that view promote to substitute Psammosol with Arenosol.
Evidently, there are many reasons for that, exponded in this article.

Key words**:** *erosion, aeolian, SRTS, WRB, soil.*

INTRODUCTION

From the broadest point of view, pedology is a study of the development of soil material. Soil material may be defined as the material occupying the outermost part of the earth’s crust and possessing distinct morphological, mineralogical, chemical and physical properties resulting from certain inheritance factors. It must be recognized that the parent material of a soil profile may consist of a variety of materials. Or it may consist of a prior soil profile. Many soil profiles exist, however, which have developed from parent material that was not uniform with depth and, as a result, evaluation of soil development in such profiles is more difficult.

As a rule, the largest area of soils is formed from the sedimentary rocks, as a result of soil – forming process, which is concomitantly with sedimentation. These processes take place at the surface of the Earth, in subaqueous or subaerial conditions. Following such processes, mineral particles of different sizes, as well as products of chemical precipitation and organism remnants, are deposited and accumulated. Soil layers development is usually strongly related to sedimentation, e.g. where loess, volcanic ash or sand deposits with interbedded iron clay (fig.1)

Fig. 1. Sand deposit with interbedded iron clay

Despite assertions by many early workers, sand deposits in Romania are predominantly of Levanntine age (East Jiu, Hanul Conachi, NW of Romania – Nir, Valea lui Mihai) [9], or Pannoniane age (Dealurile Lipovei, Lugoj, Sacoș) [7, 11]. It can be accepted that only sand deposits situated near the Danube (e.g. Dăbuleni) involves Aeolian processes in its formation.

Aeolian processes, involving erosion, transportation, and deposition of sediment by the wind are responsible for the mobilization of sand and dust and formation of areas of sand dunes. Very small particles (<20 µm) are transported in ***suspension***, large particles (20-63 µm) and (6-1000 µm) is transported in ***saltation***, and material coarser than 500 µm diameter by ***reptation*** and ***creep*** [4]

Aeolian deposits include sand seas and dune fields, deposit of silt (loess) and fine – grained material that forms a component of desert margin. Many marine and river deposits also include wind – transported material.

Sand seas have dunes, areas of sand sheets, interdune deposits (playas, lacustrine deposits), extradune fluvial, lacustrine and marine sediments. At the wind’s command, wave after of dunes sail the arid wastes of Earth’s largest sand sea, in the Saudi Arabia. Adrift in an area the size of France, each peripatetic ridge can span up to 200 kilometres with crests that peak over 300 metres. Areas of sand seas lie in the tectonically stable desert regions of the Sahara, Australia, southern Africa, and central Asia.

Sand dunes occur in a system which comprises wind ripples (005-2m), individual and complex dunes (50-500m), and complex megadunes or draa (spacing >500m). Dunes are composed of moderately to well – sorted sands (63-1000 µm), of quarts and feldspar. These are three types of structures: wind ripple laminae, grainfall laminae, and grainflow cross-strata.

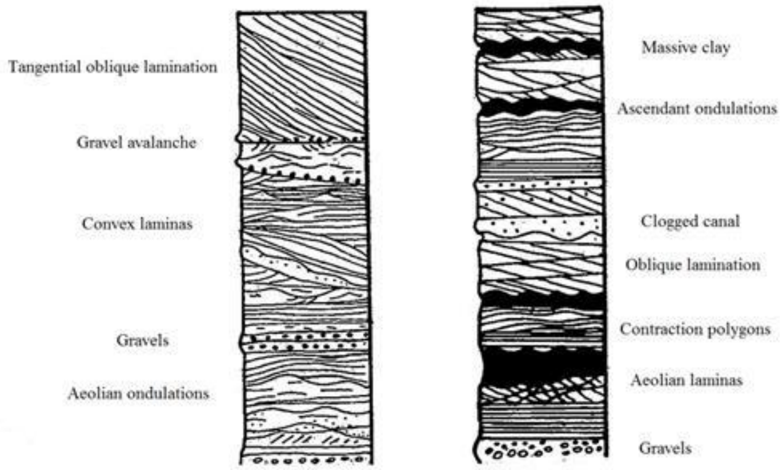

Fig. 2 Dune sedimentary structures

Preservation of Aeolian accumulations is favoured in tectonic basins. Many Aeolian deposits formed during Pliocene (Neogene Era), and Pleistocene (Quaternary Era), thus they have been affected by climatic and glacial – interglacial cycles.

MATERIAL AND METHODS

This article is going to continue the analyse about sand sediments but the accent is for sediment movement by the wind, sand seas, sand dunes, dune sediments. Nine soils profiles of sandy soils were analyzed, and the results of physical, chemical and morphological properties are discussed in order to establish and evaluate the soil resources and the potential use of different types of sandy soil cover, and the use of geological data for the benefit of soil science. One part of the soil profiles, have been analyzed by the authors, namely the soil profiles from Banat region.

RESULTS AND DISCUSSIONS

The specificity of many properties of a given soil material is the results of its unique position with respect to the surface and the substratum, and its development cannot be well understood except in relation to its position as it occurs in nature. Many profiles consist of such layers differentiated naturally by the soil – forming processes. In many soils (Buzad, e.g., 7) the soil profile is bistratified, and the preserved parent material (Pannonian sand deposit) is not a part of the soil material, but must be included because it is the reference material by which the degree of soil development can be measured. Thus, in the case of Buzad, the mineralogical composition indicate stratification, in the sandy material from the bottom of soil profile, there are epidote and staurolite which are index minerals.

Each soil horizon is characterized by one or more properties, occurring over a certain depth, with a certain degree of expression, and are consideret to be indicative of present or past soil – forming processes.

Sandy soils are recognized as a separate grouping in universal, regional and local soil classification systems. In the USDA Soil Taxonomy sandy soils, including shifting sands, are classified as Psamments. In WRB – SR sandy soils are Arenosols, and so, also, in FRB, RUSS, FAO. It is a reference soil group including soils that have a texture of loamy sand or coarser to 0 depth of ≥ 100cm from the soil surface, or to plinthic, petroplinthic or a salic horizon between 50 and 100 cm from the soil surface; and <35% rockfragments within 100 cm from the soil surface (fig. 3 and table 1)

Fig. 3 Arenosol with thin bands of clay (Debrecen, Hungary, 3)

Table 1

Analytical data – Aridic Arenosol (WRB)

	C_1	C_2	C_3
pH	7.2	6.9	7.4
Sand	96	96	96
Silt	1	1	1
OC	0.0	0.1	0.0
CECs	1.1	0.9	1.0
BSP	100	100	100
0-49 cm – C_1, yellowish red sand, massive with cross – bedding, weakly coherent, very low organic matter content; 49-72 cm – C_2, yellowish red sand, massive, weakly coherent; 72-170 cm – C_3, yellowish red sand, massive weakly coherent			

In accordance with the depositional sedimentary structures and aeolian processes, we believe that these layers of the soil profile are not a result of soil – forming processes but predominantly of the geological nature.

The Romanian Soils Taxonomyc System (SRTS – 2012) includes sandy soils of the Protisols class as Psammosol, from Greek psammite. Psammite is a detrital unconsolidated or consolidated rock that consists predominantly of sand – sized (0.05-2mm) particles. Sands and sandstones are included. Psammosol (in SRTS - 2012) is a soil type that have an A horizon (mollic, umbric or an ochric) developed in Aeolian sandy deposits ≥ 50cm thick and have ≤12% clay. A clear example of Psammosol evaluated from Aeolian sand deposit is presented in table 2., in according with SRTS – 2012.

Table 2

Analytical data – Psammosol Dune Dabuleni (SNRSS, Craiova, 2012)

	Ao 0-5cm	C_1 20-50cm	2Ao 80-96cm	C 165-190cm
pH	5.3	6.0	5.9	6.0
Sand	93.6	95.1	94.3	95.8
Silt	1.8	1.3	1.4	1.2
Clay	4.6	3.6	4.3	3.0
K	26.3	18.3	0.5	0.2
BD	1.2	1.6	1.5	1.4
OC	0.96	0.42	0.72	0.24
CECs	3.2	2.3	2.0	1.4
BSP	56	67	61	68

The clay content, between 146 cm and 149 cm depth is 6.1%, greater than in the other layers. Without mineralogical analysis, we can't have a certainty about forms or accumulates clay minerals in the soil profile.

If in the case of soil profile from Dabuleni (table 2) the parent material is Aeolian sand deposit, for area situates of NW Romania, the origin of sand is difficult to establish, very probably from Pannoniane age (table 3).

Table 3

Analytical data – Psammosol-Urziceni-Satu Mare (SNRSS, 1973, Cluj)

	0-10 cm Ao	80-95 cm BtC_1	155-165 cm BtC	215-230 cm C_2Go
pH	6.0	5.7	6.6	9.1
Sand	89.8	95.2	76.3	78.3
Silt	5.0	1.8	3.8	15.7
Clay	3.2	3.0	9.9	6.0
OC	3.2	0.2	0.7	0.2
CECs	9.68	1.7	8.29	9.21
BSP	74.6	57.3	100.0	100.0

The plus of clay content (9.9% in the layer 155-165 cm depth) is inherited from the parent material – sandy deposit which have had ferruginous clay bands.

A similar situation is of the soil profile from Copacele – Banat (table 4). All the conditions necessary for the type Psammosol (SRTS - 2012) were satisfied, but the sand deposit is not an Aeolian sand deposit, and for that the soil profile can't be Psammosol; the nature of sand deposit is from Pliocene age.

Table 4

Analytical data – Psammosol - Copacele

	Ap 0-20 cm	Ao 20-45 cm	C 45-76 cm	C 76-120 cm
pH	5.6	5.5	5.5	5.4
Sand	68.3	72.2	80.6	83.5
Silt	19.9	21.6	14.4	13.8
Clay	11.8	6.2	5.0	2.7
BD	1.4	1.7	1.8	-
K	13	18	11	-
OC	2.3	1.4	0.6	-
BSP	65	66	68	73

In the Aranca plain, communal territory Lovrin, there are 211 ha of sandy soils; the origin of parent material is from Pleistocene, a loamy coarse sand which alternate in the region with loess-like deposit, in many cases the soil profiles are considered Psammosols, but the condition – aeolian sand is not satisfied (table 5, 6).

Table 5

Analytical data – Psammosol Lovrin, 68

	Ap 0-23 cm	C 43-62 cm	Cg 62-95 cm	CGo 107-138 cm
pH	5.0	5.9	6.2	6.9
Sand	84.7	86.3	86.9	91.2
Silt	5.0	1.9	1.8	2.2
Clay	10.3	11.8	11.3	7.6
BD	1.5	1.5	1.5	-
K	16	14	12	-
OC	2.7	0.9	-	-
BSP	57	81	83	90

Table 6

Analytical data – Psammosol Lovrin, 69

	Ap 0-34 cm	Am 34-43 cm	C 63-95 cm	CGo 95-140 cm
pH	8.2	8.3	8.5	8.7
Sand	79.9	86.1	93.2	94.1
Silt	7.9	5.0	1.6	1.6
Clay	12.2	8.9	5.2	4.3
BD	1.2	1.3	1.4	-
OC	2.6	1.0	-	-
$CaCO_3$	85	8.6	5.9	4.4

It is evidently that the condition "aeolian sand" is too restrictively for Psammosol, and in numerous situations create uncertainty.

In the modern geology, clastic sedimentary rocks are classified into rudite, arenite, siltite, lutite. These terms proceed from Latin language, as well as Romanian language. In this meaning, it is natural to change Psammosol into Arenosol (Latin language: arena = nisip, in Romanian language, meaning “sand”), including all sand deposits, not only aeolian sand, also for eliminate the uncertainties.

CONCLUSIONS

Soil layers development is usually strongly related to sedimentation, e.g. where loess, volcanic ash or sand deposits with interbedded iron clay. Despite assertions by many early workers, sand deposits in Romania are predominantly of Levanntine age or Pannoniane age.

Aeolian deposits include sand seas and dune fields, deposit of silt (loess) and fine – grained material that forms a component of desert margin. Many marine and river deposits also include wind – transported material.

Many Aeolian deposits formed during Pliocene and Pleistocene, have been affected by climatic and glacial – interglacialcycles. Nine soils profiles of sandy soils were analyzed.

In many soils (Buzad, e.g., 7) the soil profile is bistratified, and the preserved parent material (Pannonian sand deposit) is not a part of the soil material.

In WRB – SR sandy soils are Arenosols of loamy sand or coarser to 0 depth of ≥ 100 cm from the soil surface and <35% rockfragments.

In accordance with the depositional sedimentary structures and aeolian processes, we believe that these layers of the soil profile are not a result of soil – forming processes but predominantly of the geological nature.

Psammosol (in SRTS - 2012) is developed in aeolian sandy deposits ≥ 50cm thick and have ≤12% clay.

The plus of clay content (9.9% in the layer 155-165 cm depth) is inherited from the parent material.

In the modern geology, clastic sedimentary rocks are classified into rudite, arenite, siltite, lutite. Proceed from Latin language. We propose to change Psammosol into Arenosol.

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