SEDIMENTARY PROCESSES

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Abstract: *Plate tectonics can explain the occurrence and formation of the entire catalogue of geological phenomena. There are intimate connections between air and water, and scientists tend to treat them as a single system. Earth's geological history is a many – leaved volume, written by erosion, layer by sedimentary layer, in silt and sand on the ocean floor. Not all sands end up neatly stacked in wind – hewn dunes: up to a billion tons are blown into the atmosphere and scattered across the globe, every year, reaching Europe and of course Romania. Riding the trade winds, Saharan sand storms can cross the entire Atlantic, clouding the skies of Miami and even delivering mineral nutrients to the Amazon.*
In Romania, sand deposits are found on 400,000 ha, predominantly in Oltenia province (170,000 ha). On the west of Romania sands occur on 16,895 ha. But it is necessary to underline, that a great area with sand deposits are widely distributed under soil profiles. The research is based on some pedological studies effectuated in Romania, especially in the west part of the country by the authors of this article. When water or air flows over a bed of loose particles, the boundary shear stress tends to initiate particle movement. By fluid, sediment is transported in two distinct ways: in "suspension" (clay, silt, sand), and in "saltation" (sand particles). Wind blowing aer dry sand, initiates movement in much the same way as water. The result is that sands moved by air tend to be well sorted and also well rounded. In addition, tectonic structures, like in Pannonian Sea, are often identical with syn-depositional structures. In the hilly zone, named Dealurile Lipovei, we present a soil profile – Luvosol stagnic (WRB – Stagnic Luvisols) bistratified, with A-El-Bt horizons, between 0 cm and 78 cm, and C horizon composed from sandy deposit with silt (23-24%) and clay (11%). The minerals which were found as new are epidote, zoisite, tourmaline and staurolite. They proceed from volcanic ash. The non-resistant minerals (biotite, hornblenda) changes with depth, whereas that of the quartz, feldspar and muscovite, remains nearly constant. The heavy resistant minerals present in the upper part of soil profile indicate stratification. In moderately weathered soils, the clay content and clay minerals are highest at the surface soil (0-60 cm) and disappeared in the sandy material (60-120 cm). There is a good correlation between the kind of clay minerals and the amount of rainfall or drainage conditions. Low rainfall and weak drainage, expandable minerals predominates(60-76%).

Key words: *Erosional sedimentary, Depositional sedimentary, Aeolian processes, Alteration of minerals.*

INTRODUCTION

The lithosphere, hydrosphere and atmosphere are but a thin skin over the rocky bulk of Earth's mantle and its dense metallic core. At the planet's heart, temperatures exceed $4{,}700^0$C – as hot as the surface of the sun – and the pressure is 3 million times that of the atmosphere at the surface.

Only in the last four decades have we made sense of all that twisted rock. The key to the code was plate tectonics, a concept some have hailed as geology's Grand Unifies Theory. Plate tectonics can explain the occurrence and formation of the entire catalogue of geological phenomena, from mountain ranges to deep ocean trenches, and suggests that earth's thin crust floats on the mantle and is broken into 15 or more pieces. Each plate is free to move and has three possible modes of interaction with its neighbours: convergent (two plates push against one another); divergent (two plates move away from each other); and transform (two plates slide past one another). The power source for all this activity is believed to leak from an 8 – kilometre ball of uranium at the centre of the planet. [1]

Earth's hydrosphere covers more than 70 percent of our planet's surface. First appearing 3.8 billion years ago, its exact origin is contested: conventional wisdom condenses it solely from volcanic out – gassings; more recent speculation delivers some of it to Earth as frozen chunks of cometary ice. At least 400 million years old, the Finke River in central Australia is reputed to be the world's oldest. By comparison, Earth's oceans are entirely no older than 200million years. Without water there is no doubt our planet would be uninhabitable. [2]

There are intimate connections between air and water, and scientists tend to treat them as a single system. At the more violent end of the meteorological spectrum, the energies unleashed are prodigious; thunderclouds can suck half a million tones of water vapour up to 15 kilometres into the air; watching thunderstoms spark hurricanes, exploring turbulent vortices spinning from mountain peaks and tracking the rolling progress of wind – sculpted sand seas as they crawl across the continents.

Earth's surface is a thing of shreds and patches, a 4-billion – year – old geological palimpsest inscribes by a deep tectonic hand, erased by the subtle, teeth of erosion, and over – written again and again. Mere flotsam on the magmatic seas that churn within the planet, the crust is in constant flux: oceans wax and wane, continents marry and separate, mountains erupt and erode. Earth's geological history is a many – leaved volume, written by erosion, layer by sedimentary layer, in silt and sand on the ocean floor. Here, tectonic convulsions have seized thinly bedded sheets of sandstone, siltstone, and limestone heaves them on edge and thrust back to the surface, where rivers bares into them and the whole cycle begins again. A good example is a dark crest of Nubian (Libya) sandstone surfaces between the Erg Awbari and the Erg Murzuq. Laid down by theTethys Ocean some 150 million years ago, this is the rock that feeds the Sahara's dry seas with sand. Deep underground, it conceals another ocean: steeped in ice-age meltwaters, this porous stone holds over 100,000 cubic kilometres of fresh water.

Not all sands end up neatly stacked in wind – hewn dunes: up to a billion tons are blown into the atmosphere and scattered across the globe, every year, reaching Europe and of course Romania. Riding the trade winds, Saharan sand storms can cross the entire Atlantic, clouding the skies of Miami and even delivering mineral nutrients to the Amazon.

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. Common features are a sparse or nonexistent vegetation cover, a supply of fine sediment (clay, silt, sand), and strong winds.

The vast expanse of deep Aeolian sand covering parts of the central African plateau between the equator and 30^0 southern latitude is the largest sand body on Earth. Popularly known as the Kalahari Sands, it is bordered by the Congo river in the north and the Orange river in the south. Other major areas are found in the Sahel region of Africa, various Earth, each ridge can span 200 kilometres with crests than peak over 300 meters. Registan Desert (Afganistan), Taklimakan Desert (China), Simpson Desert (South Australia). Coastal dunes, litoral and lacustrine sands of beach ridges, lagoons, deltas and lakes. The whole coverage would be about 10 percent of the land surface – 1 billion ha.

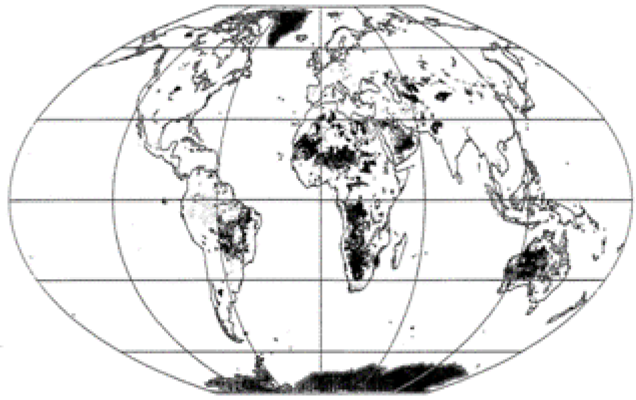

Figure 1 Distribution of sand deposits

In Romania, sand deposits are found on 400,000 ha, predominantly in Oltenia province (170,000 ha). On the west of Romania sands occur on 16,895 ha. But it is necessary to underline, that a great area with sand deposits are widely distributed under soil profiles in the region Banat, a layer of about 800-1600 meters thickness.

MATERIAL AND METHODS

The research is based on some pedological studies effectuated in Romania, especially in the west part of the country by the authors of this article. There are discusses some of the processes involved in sediment erosion, sediment transport and deposition, dunes, sand waves and cross-bedding, post-depositional sedimentary processes. For some sandy soil profile and sand deposits we present the analytical data and the possibilities to use. The comparison between Psamosols and Arenosols remarks a great similitude.

RESULTS AND DISCUSSIONS

This article deals with some of the processes involved in sediment erosion and reviews the range of distinctive structures that are produces, it deals solely with features that are present where overall accumulation has occurred, with sediment transport and deposition aeolian bedforms and internal bedding sediment movement by the Wind, aeolian deposits, Psamosols and Arenosols.

When water or air flows over a bed of loose particles, the boundary shear stress tends to initiate particle movement. The cohesive strength of fine-grained damp or wet, increases with the time following deposition and is augmented by shallow burial. [5] Erosional sole marks are relatively small – scale structures preserved as casts on the bases of sandstone. [6]

They are valuable indicators of erosional and depositionl processes and suggests that the sands were deposited episodic in deep water, in shelf settings, and as flood events in deltaic and alluvial settings. Sole marks due to fluid turbulence may be classified into three main groups: obstacle scours, flute marks, and longitudinal furrows.

On present – day subaerial sediment surfaces, e.g. tidal, flats, beaches, river beds, and desert flats, it is possible to find structures that record erosion by recent currents, both water and wind. Wind ridges occur where strong winds blow across damp sands as on a beach. Channels occur in a wide range of settings as an integral part of the depositional process, with varied shapes. [7]

By fluid, sediment is transported in two distinct ways: in “suspension” (clay, silt, sand), and in “saltation” (sand particles).

When sand starts to move, the surface becomes covered by “current ripples”, a few centimetre high and a few ten centimetres in wave-length. In three dimensions, the geometry of ripple cross-lamination occurs as a series of intersecting troughs, each filled with curved cross-laminae that are concave both upwards and downstream.

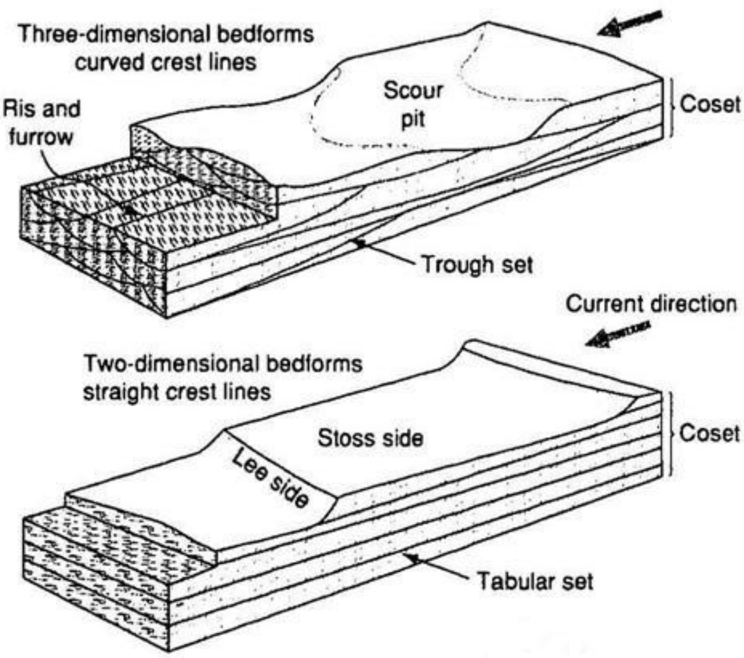

Figure 2 Cross-bedding and cross-lamination

A current velocities increase above those appropriate for ripples, sand beds deform into “dunes” or “sand waves”. As well as producing ripples, waves also create plane bed conditions, with parallel lamination, and undulatory lamination.

Nature of deforming force \ Loss of strength		Exceed strength of sediment: Internal tensile (Brittle)	Exceed strength of sediment: Internal cohesive (Plastic)	Exceed strength of sediment: External surface cohesive (Plastic)	Liquidize: Liquefied	Liquidize: Fluidized
Gravitational body force on slope		Slides	Slumps	Slumps and slides	Debris flows	
Unequal confining load		Growth faults	Loaded ripples shale ridges and diapirs		Loaded ripples and sole marks	
						Clastic dykes sand volcanoes
Gravitationally unstable density gradient (density inversion)	Continuous	Soft sediment faults			Convolute lamination	
	Within a single layer				Dish structures	Water-escape pipes and pillars
	Multiple layer, not pierced				Bedding surface load casts	
	Multiple layer, pierced		Shale ridges and mud diapirs		Ball and pillow/pseudonodules Isolated load balls	
Applied shear stress	Current drag				Overturned cross-bedding	
	Vertical					Water-escape pipes and pillars

Figure 3 Sedimentary deformational structures [4]

Wind blowing aer dry sand, initiates movement in much the same way as water. The result is that sands moved by air tend to be well sorted and also well rounded. Powerful water currents also transport gravel, and its deposition can lead to distinctive structures and fabrics. Above the bases, sandstones show one or more intervals of different lamination types. In addition, tectonic structures, like in Pannonian Sea, are often identical with syn-depositional structures [8].

In a stratigraphic column from Banat region (Gherasi, N., 1968), sandy deposits with about 200-500 meters thickness, are Pannonien age, and are situated below Quaternary stratum. In the hilly zone, named Dealurile Lipovei, we present a soil profile – Luvosol stagnic (WRB – Stagnic Luvisols) bistratified, with A-El-Bt horizons, between 0 cm and 78 cm, and C horizon composed from sandy deposit with silt (23-24%) and clay (11%).

Table 1

Analytical data (Buzad)[9]

	10-29 cm	-37 cm	-60 cm	-86 cm	-120 cm
Sand	50.4	50.0	47.9	53.6	63.6
Silt	19.1	15.0	24.5	24.2	25.4
Clay	30.5	35.0	27.6	22.2	11.0
pH	5.35	5.47	5.80	6.12	6.45
OC	1.37	0.90	0.47	0.40	-
CECs	30.7	24.5	32.9	34.9	30.5
BSP	66.1	70.8	82.2	91.2	87.2

Very significant is the soil mineralogy, respectively the light minerals content and the clay minerals content [9]

Table 2

Mineralogical composition (%)

I.	Depth, cm				
Light and heavy minerals	10-29	-37	-60	-86	-120
-quartz	35.1	33.7	32.3	29.8	29.8
-feldspar	24.3	17.6	23.7	25.6	27.5
-muscovite	37.1	36.6	37.4	32.4	27.6
-biotite	-	1.7	-	1.1	0.5
-garnet	0.69	0.73	0.42	-	0.63
-hornblende	0.57	0.60	0.35	-	-
-epidote	-	0.63	0.73	1.85	1.10
-zoisite	0.60	-	0.74	-	-
-tourmaline	-	0.59	-	-	-
-magnetite	-	0.99	0.57	-	2.59
-staurolite	-	0.70	1.64	-	1.85
II.					
Clay minerals					
-expandable	60	65	76	-	-
-illite	37	32	21	-	-
-kaolinite	3	3	3	-	-

A qualitative mineralogical analysis is very useful in differentiating materials from different sources. Use of the pattern of particle-size distribution of resistant minerals to identify uniformity of a mineral with depth reveals that these minerals change during the course of soil formation (0-60 cm differs from 60-120 cm). The minerals which were found as new are epidote, zoisite, tourmaline and staurolite. They proceed from volcanic ash. The non-resistant minerals (biotite, hornblenda) changes with depth, whereas that of the quartz, feldspar and muscovite, remains nearly constant. The heavy resistant minerals present in the upper part of soil profile indicate stratification. In moderately weathered soils, the clay content and clay minerals are highest at the surface soil (0-60 cm) and disappeared in the sandy material (60-120 cm). There is a good correlation between the kind of clay minerals and the amount of rainfall or drainage conditions. Low rainfall and weak drainage, expandable minerals predominates(60-76%).

Similarly conditions are in the other zone studiated, Cornutel, situated near the town Caransebes, also in a hilly area. Here, the Pliocene deposit arrived at the surface, because of erosional processes, and represents the parent material for an Arenosols (WRB) [10, 12].

Table 3

Cornutel – Ezeris Depresion

	Depth, cm				
	0-2	-35	-56	-145	-225
Sand	85.7	82.6	82.1	78.3	82.2
Silt	6.9	9.2	10.1	7.9	7.0
Clay	7.4	8.2	7.8	13.8	10.8
pH	6.2	5.9	5.7	5.4	5.3
OC	2.0	1.9	1.7	-	-
CECs	3.0	3.4	2.7	2.5	4.0
BSB	13.1	20.1	11.7	23.9	31.3

Soils are very permeable, and have rapid infiltration, high hydraulic conductivity and low water holding capacity.

CONCLUSIONS

Earth's geological history is a many – leaved volume, written by erosion, layer by sedimentary layer, in silt and sand on the ocean floor. Here, tectonic convulsions have seized thinly bedded sheets of sandstone, siltstone, and limestone heaved them on edge and, thrust them back to the surface, where rivers bores into them and the whole cycle begins; up to a billion tones are blown into the atmosphere and scattered across the globe every year. Romania has a great area with sand deposits of the surface, about 400,000ha, but moreover of that, below the soil profile, in many hilly areas, especially in Banat, there are sand deposits. In a stratigraphic column, below Quaternary stratum there is a sandy deposit of about 200-500m thickness. Mineralogical analysis have had distinguished a bistratified soil profile (Buzad): an upper part (0-60 cm) with an uniform quantity of quartz, feldspar and muscovite, and clay minerals, predominantly expandable minerals; the subjacent stratum, with coarse texture, is without clay minerals. For such type of material, the soil type can be Arenosols, which has a texture of loamy sand and coarse fragments..

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