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Landslide Hazard Assessment Models at Regional Scale – *Dobrogea region*

Ovidius University of Constanta (P4) -Romania

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1. **Landslide Susceptibility (static conditions)**

    1. Geology (lithology per geologic group)
    2. Slope angle (slope inclination)
    3. Underground Water Table

2. **Landslide Susceptibility (seismic conditions)**

    4. Critical Acceleration (Ac) defined as the horizontal acceleration

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Landslide susceptibility of geologic groups under static conditions – FEMA method

Geologic Group		Slope Angle, degrees					
		0-10	10-15	15-20	20-30	30-40	>40
(a) DRY (groundwater below level of sliding)							
A	Strongly Cemented Rocks (crystalline rocks and well-cemented sandstone, $c' = 300$ psf, $\phi' = 35°$)	None	None	I	II	IV	VI
B	Weakly Cemented Rocks and Soils (sandy soils and poorly cemented sandstone, $c' = 0$, $\phi' = 35°$)	None	III	IV	V	VI	VII
C	Argillaceous Rocks (shales, clayey soil, existing landslides, poorly compacted fills, $c' = 0$ $\phi' = 20°$)	V	VI	VII	IX	IX	IX
(b) WET (groundwater level at ground surface)							
A	Strongly Cemented Rocks (crystalline rocks and well-cemented sandstone, $c' = 300$ psf, $\phi' = 35°$)	None	III	VI	VII	VIII	VIII
B	Weakly Cemented Rocks and Soils (sandy soils and poorly cemented sandstone, $c' = 0$, $\phi' = 35°$)	V	VIII	IX	IX	IX	X
C	Argillaceous Rocks (shales, clayey soil, existing landslides, poorly compacted fills, $c' = 0$ $\phi' = 20°$)	VII	IX	X	X	X	X

✓ Steps to realize

1. classification of geologic group
2. slope angle
3. hydraulic conditions (dry / wet)

Arbitrary scale

- ✓ **scale I:** less susceptible
- ✓ **scale X:** most susceptible

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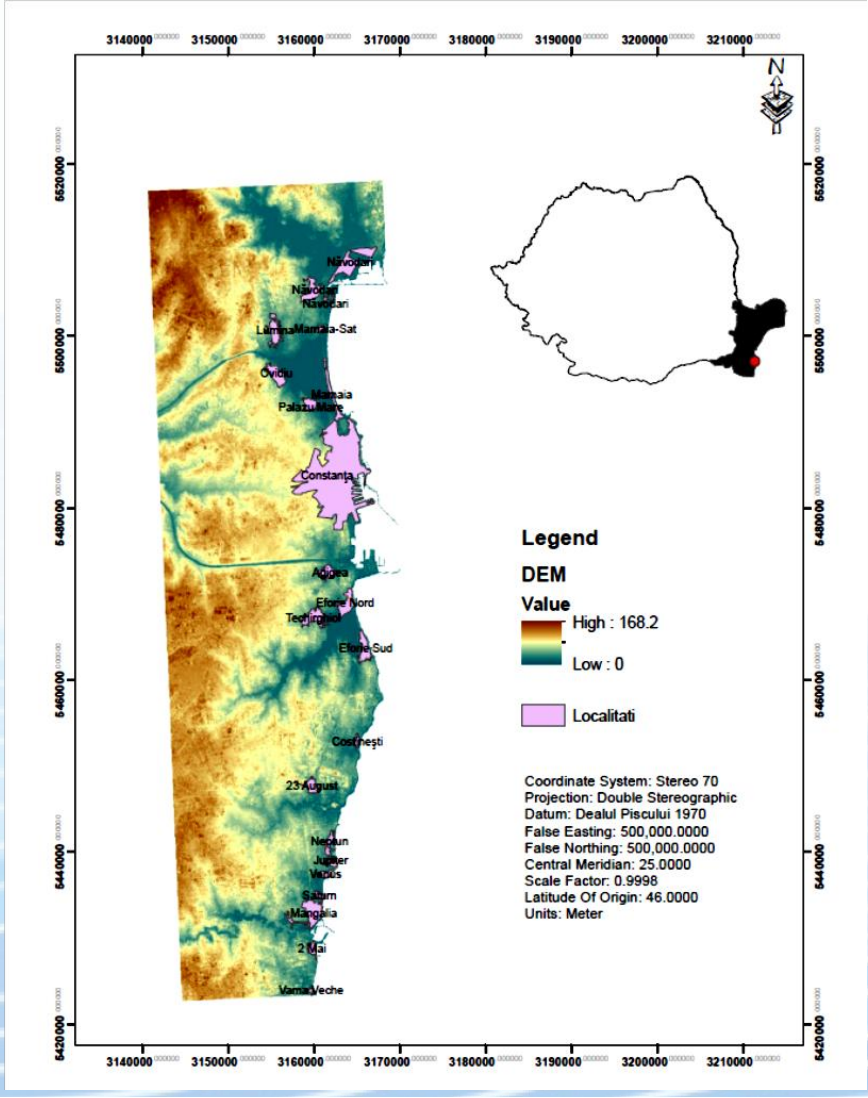
Study area

Dobrogea is located in the south-eastern extremity of Romania, covering the area between the Danube (western and northern borders) and the Black Sea (eastern border);



The Littoral Coast line from Constanţa to 2 Mai village is about 50 km along the Black Sea coast, crossing the Danube – Black Sea Canal at Agigea and passing through several resorts – Eforie Nord, Eforie Sud, Techirghiol, Costineşti and Mangalia.

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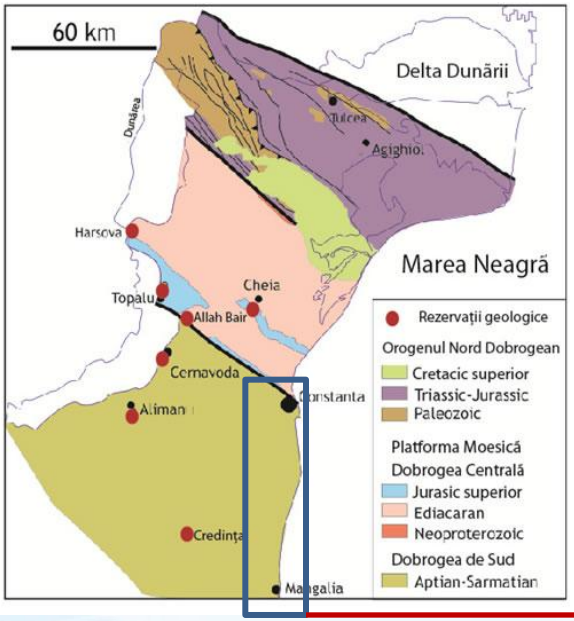
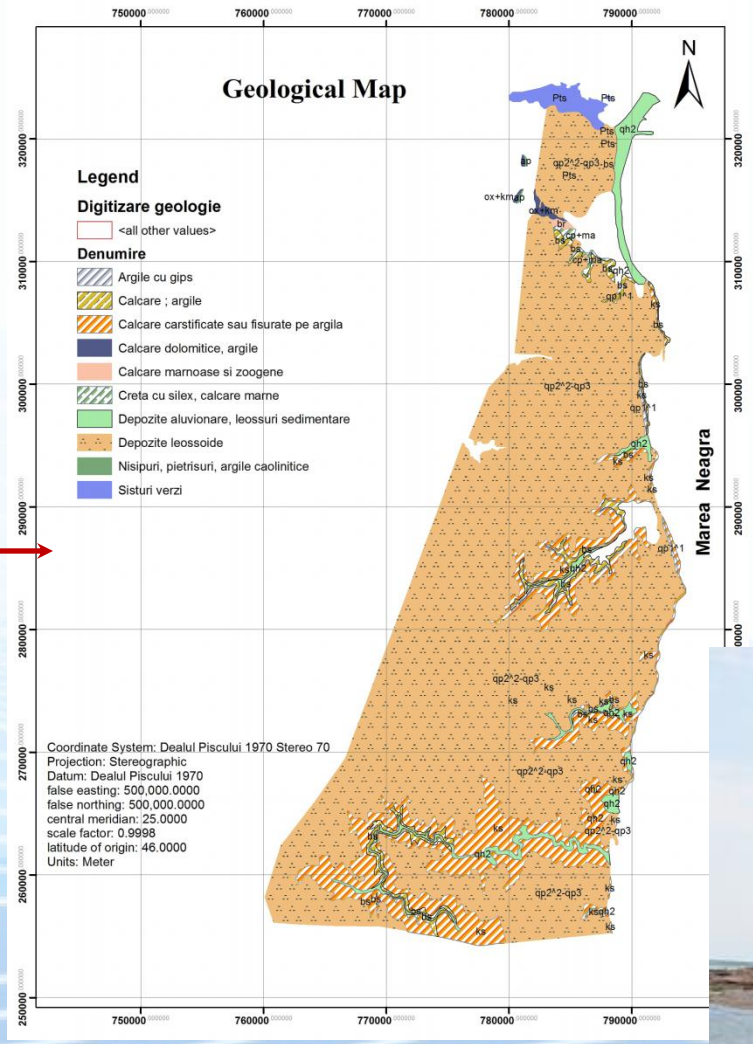
Geological map



mmon borders. Common solutions.



The common feature of the three units of Dobrogea is the vast Quaternary cover, having various thicknesses loess layers.
There are in small percentage: green schist, limestone and redish clay

This area includes three tectonic units – Northern, Central and Southern Dobrogea. The tectonic units are separated by two major crustal faults, approximately oriented NW-SE: Peceneaga-Camena (between North and Central Dobrogea) and Capidava-Ovidiu (between Central and the Southern units).

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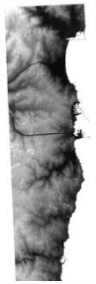
Methodology steps

Landslide susceptibility *(static condition)*

Common borders. Common solutions.

DEM ASTER 30X30 m



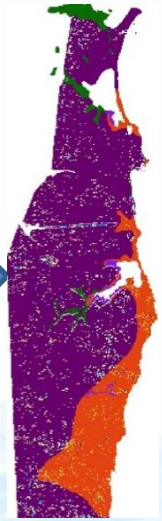
Slope raster

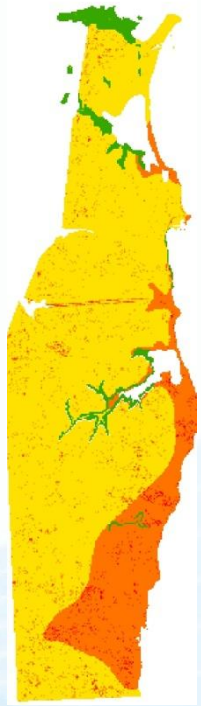
Slope reclass.

Slope class
1-10
10-15
15-20
20-30
30-40
>40

Slope + Geologic group.

Landslide susceptibility map





Geological map

Raster geology

Geology reclass.

Geologic group
A
B
C

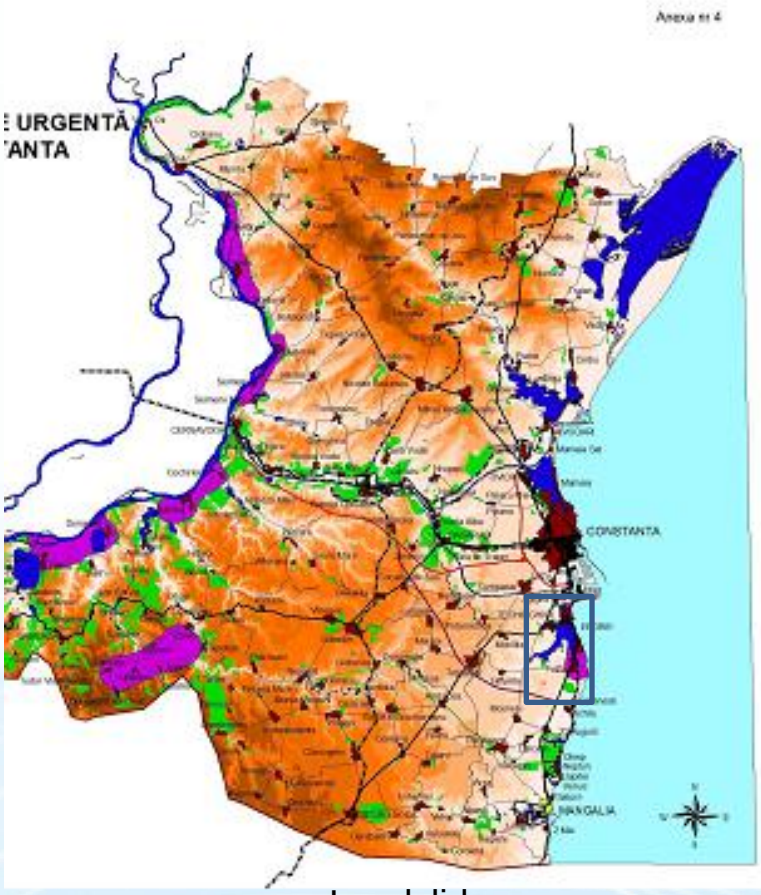
water table map

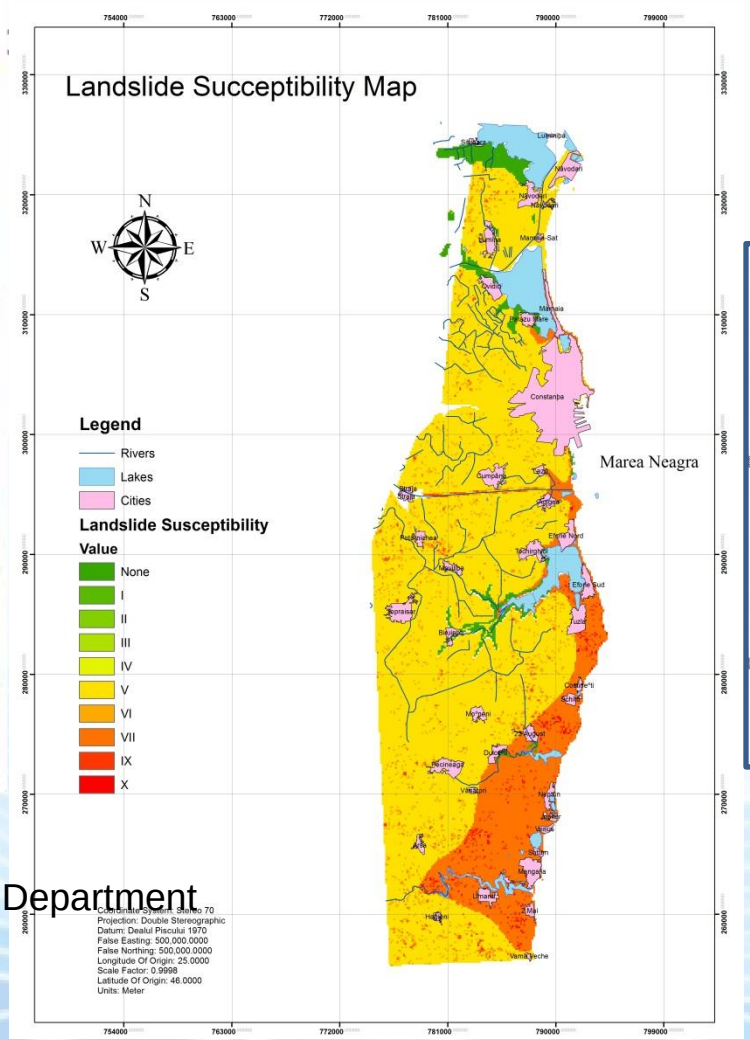
Raster water table

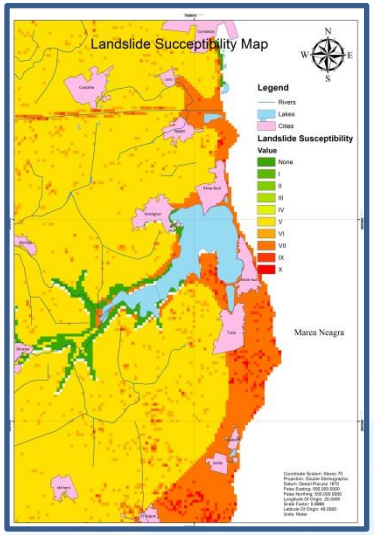
WT reclass.

Water table
Dry
Wet

Hazus scale
scale I: less susceptible
scale X: most susceptible



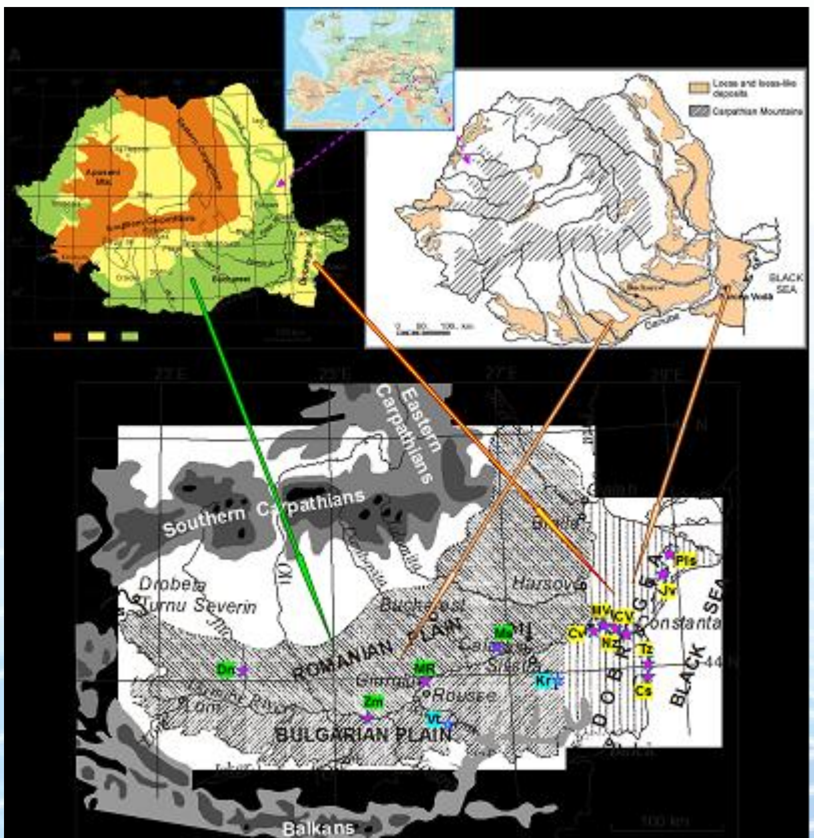




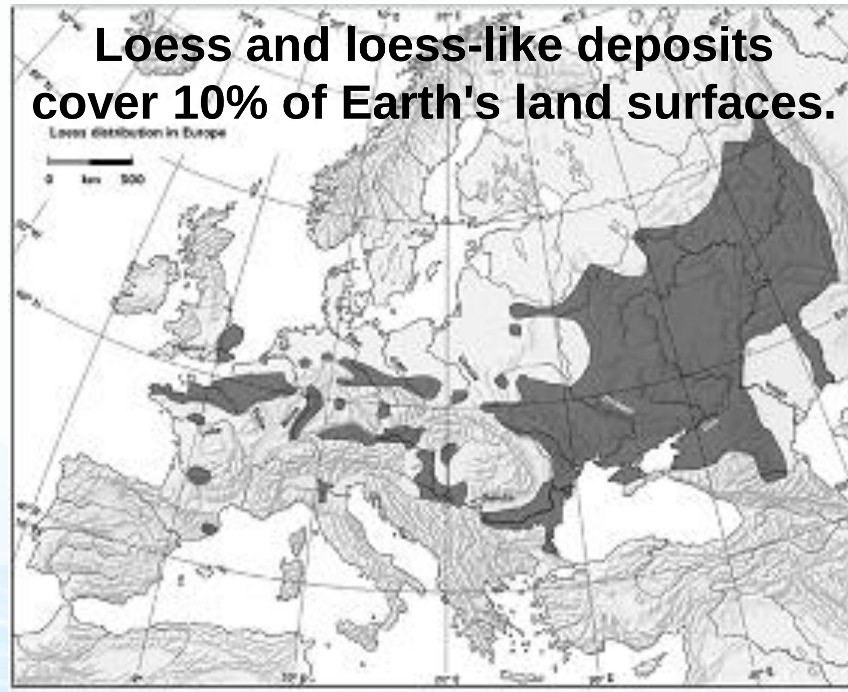
Landslide prone area
by
Constanta county Emergency and Security Department
(INSRA method)

Loess distribution

Loess in Romania occupy an area of 17% of entire country.



Loess and loess-like deposits cover 10% of Earth's land surfaces.



Loess distribution in Europe (Smalley et al., 2009)

Location of the most important loess Romanian Plain and Dobrogea (Romania)

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Loess in Dobrogea

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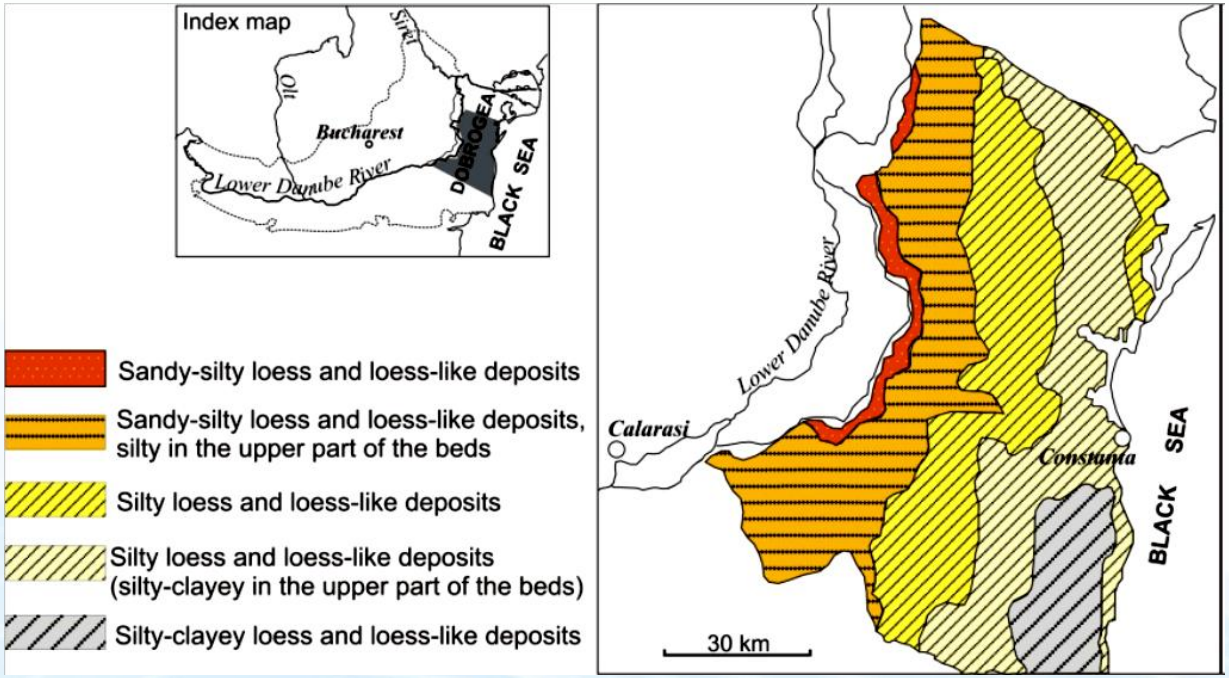
types of loess and loess deposits in Dobrogea



Geotechnical parameters

Param	Clay %	Silt %	Sand %	W_L%	W_P %	w %	n %	S_r	M_{2-3} DaN/cm2	i_{m3} cm/m	Φ (grade)	c kPa
Min	14	50	3	32	12	7.8	46	0.4	18.7	0.6	5	5
Max	29	80	18	40	17	28.5	54	1	107	15	30	48

Characteristics

The loess:

- unconsolidated,yellow, unstratificated and uniform rock;
- silty texture (with prevalent 0,05-0,01 mm elements), and without coarse
- high porosity (40-50%);
- very low or without plasticity;
- carbonates equal dispersed in rock and precipitate as limes concretions;
-favorise the subsidence, erosion and landslide (regressive).

The loess deposits:

- unconsolidated rocks, with different colors, sometimes with stratifications and various uniformity;
- different mechanical composition (clay, sand,silt), with coarse sand and/or gravel;
- various porosity, generally low;
- various plasticity, depending on mechanical composition;
- carbonates dispersed;
- the subsidence and the compaction processes are not characteristics;
- they could be quickly and radical transformed by secondary processes.

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Coastline image of Eforie Nord
1963

Eforie Nord

Landslide February 2015

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Coastline image of Eforie Sud
1963

Eforie Sud

Landslide February 2015

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Thank you !