

GEOLOGICAL CHARACTERIZATION OF LOESSOID SOILS FROM ROMANIA

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Abstract

Loess is a deposit of wind-blown silt that blankets large areas of the continents. It is often light brown in color, consisting predominantly of quartz, feldspars, micas, and calcium carbonate. Geographically, loess is extensive in the North American Great Plains, south-central Europe, central Asia, and central East of South America. In Europe, loess deposits are common in areas that lie between the former Alpine and the Scandinavian ice sheets and in regions to the east associated with major river systems. In Romania, loess was described by Gr Stefanescu in 1895 and the aeolian origin of the loess was stated for the first time by L. Mrazec, in 1899. Loessoid soils are very common in Romania, mainly in Dobrogea, Galati, Braila; they are found over some 19% of the area (Popescu, 1965). The aim of this paper considers the main topics of loess distribution, different hypotheses of its origin and geological characterization of these problematic soils.

Key words: loess, Romania, aeolian deposits.

INTRODUCTION

The loess term was added since 1903 by Charles Lyell, and it comes from word of German origin "lose" or "loss" defined as "loose, porous, brittle". Loess is a sedimentary rock, unconsolidated, quaternary age, home wind, yellow-gray, with a porous appearance, made mostly of silica dust and clay.

Loess soils and loess deposits are very sensitive to wetting due to high porosity: 40-50%. If intense moisture, compaction increases relatively sharply, gaining character of collapse. Loess deposits represented typical sensitivity to wetting was formed by wind action, which moved microparticles of dust from arid to semi-arid regions, depositing them over existing vegetation. With time, the rotted vegetation layer form vertical ducts which causes a much higher permeability in this direction and a very loose structure.

The spread of the loess deposits range from 5% in South America, 7% in Europe, to 16% in Asia. In Romania, loess covers 19% of the area (Popescu, 1965). On average, in Europe, the thickness of loess deposits is 30-40 meters, while in Asia can reach up to 400 meters.

MATERIALS AND METHODS

In order to analyze the geological characterization of loessoid soils from Romania we used a number of experimental studies from the professional literature. The activity in the first stage of the study focused on accumulating published information about the loess formation and loess-like deposits in the world and in Romania.

During the second stage of the study, we have visually examined the characteristics of a loess deposit.

RESULTS AND DISCUSSIONS

Loess formation in the world

Loess is a deposit of wind-blown silt that blankets large areas of the continents. It is often light brown in color, consisting predominantly of quartz, feldspars, micas, and calcium carbonate (Pye, 1987). Geographically, loess is extensive in the North American Great Plains, south-central Europe, Ukraine, central Asia, China, and Argentina (Figure 1).

In North America, loess was derived from both glacial and nonglacial sources (Bettis et al., 2003) but is commonly related to formerly extensive outwash deposits from the Laurentide ice sheet and to the floodplains of large, braided rivers; sections along the Mississippi River valley may reach 20 m in thickness (Oches et al., 1996). The thickest loess deposits are found in the unglaciated regions of Alaska (up to 50 m) and in Nebraska (up to 48 m) where the LGM (Peoria) loess was derived from bedrock sources northwest of the region (Chapter loess).

Loess in Europe

In Europe, loess deposits are common in areas that lie between the former Alpine and the Scandinavian ice sheets and in regions to the

east associated with major river systems (Figure 2). Some of the thickest loess sections are related to formerly extensive braided rivers at a time when vegetation cover was greatly reduced (primarily grassland) (Fitzsimmons et al., 2012). Although rarely continuous, some sites have loess and paleosol sequences that extend back into the Early Pleistocene (particularly in the middle and lower Danube River Basin, e.g., at Stari Slankamen in Serbia and at Stranzendorf and Krems in Austria; (Markovic' et al., 2011). Elsewhere, loess is related to desert conditions, especially the extensive deserts of central Asia where weathered material, transported from adjacent mountain ranges, has accumulated (Smalley et al., 2009). These vast arid areas, and the adjacent Yellow River system, are the source regions for the extensive Chinese loess deposits (Stevens et al., 2013). In north-central China (southeast of the Gobi Desert), loess deposits are extremely thick, up to 300 m in places, and completely cover the underlying topography, forming a loess plateau that extends over an area of 500,000 km². It is there that the most comprehensive paleoclimatic studies of loess deposits have been carried out.

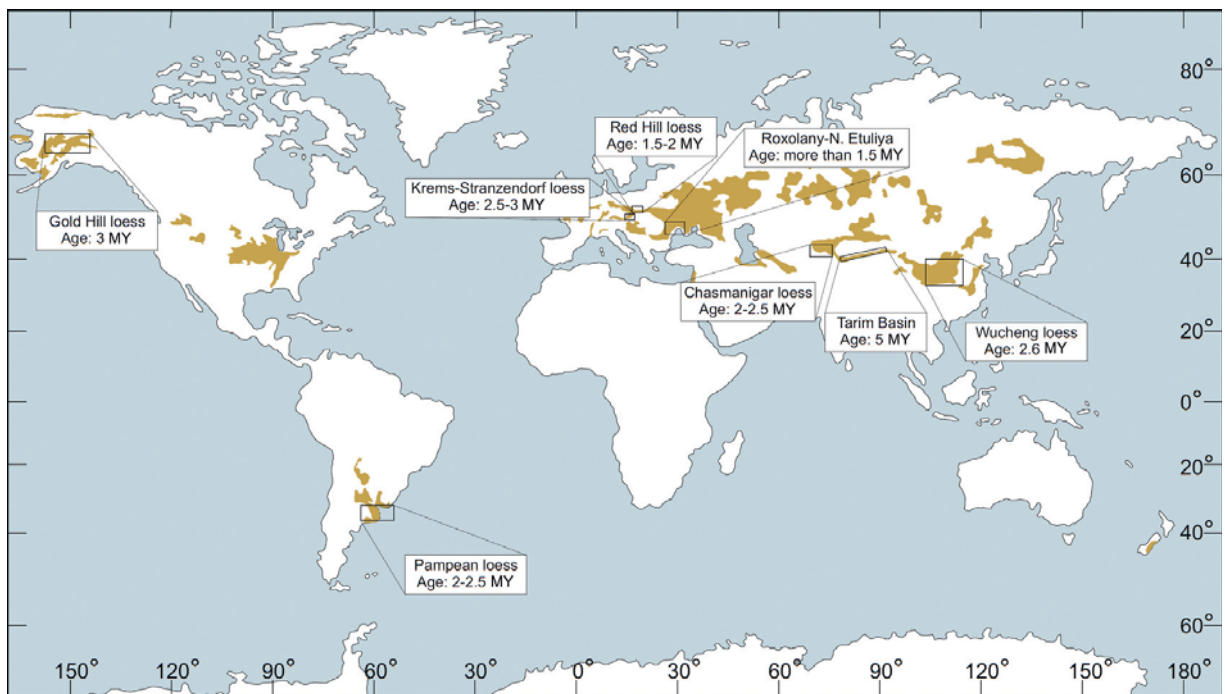


Figure 1. Global distribution of loess deposits. (Varga 2011)



Figure 2. Loess distribution in Europe. Loess distribution is related to the former extent of ice sheets and the distribution of major river systems (Smalley et al., 2009)

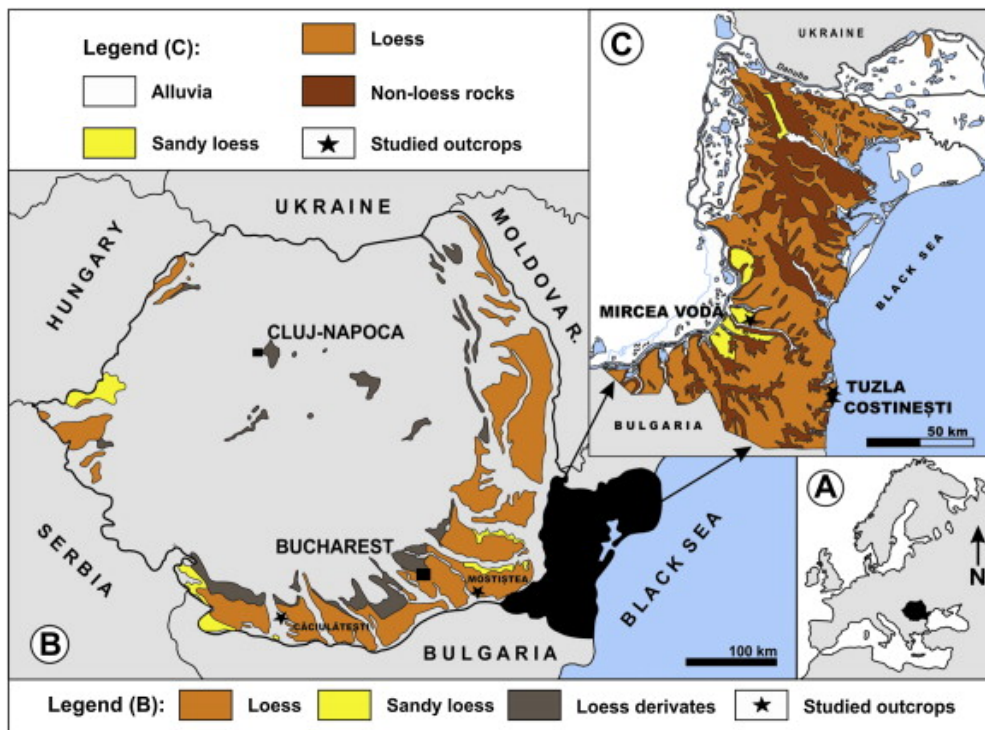


Figure 3. Loess distribution in Romania (Constantin et al., 2013)

Loess in Romania

In Romania, aeolian origin of the loess was sustained for the first time by L. Mrazec, in 1899, in paper "Comunicare asupra loessului din Romania".

The bases of the loess and paleosoils studies there have been set, at the beginning of the XXth century, by Gh. Murgoci and his contributors, Emm. Protopopescu-Pache and P. Enculescu (1908, 1910). They were sustained the Aeolian origin of the loess (the sources were, at last for the eastern part of the Romanian Plain, the alluvia of the rivers which cross the plain), they shown that the red layers from loess are paleosoils and, by analyze of those, "we could deduce the climatic changes from Romania from the age of the loess sedimentation" (Gh. Murgoci, Emm. Protopopescu-Pache and P. Enculescu 1908-1910).

In 1903 Simionescu shown that in Moldavia, between Siret and Prut rivers, the loess-like deposits have alluvial origin (there are formed in the same period with melting of the north-European ice-sheet). In 1908, R. Sevastos studied the loess from Moldavia, consider that it is aeolian deposit formed by sedimentation of the dust brought by winds from Asiatic deserts or from the north-European ice fields.

The loess and loess-like deposits characteristics

In many studies published in the scientific literature there have been made no differences between loess and loess-like deposits, but there were often used the both terms for deposits with different textures. Liteanu and his contributors used, for the deposits from the Romanian Plain, only the term loess-like deposits, with different mechanical composition. Conea (1963) made an paralleled description of the loess and loess like deposits, which we resume below:

The loess:

- unconsolidated, yellow, unstratificated and uniform rock;
- silty texture (with prevalent 0,05-0,01 mm elements), and without coarse

elements;

- high porosity (40-50%);
- with very low or without plasticity;
- carbonates equal dispersed in rock and precipitate as limes concretions;
- favorise the subsidence and is easily to erodate.

The loess-like 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.

The loess has more than 60% particles between 0,01 and 0,1 mm and loess-like deposits have less than 60% of that particles.

In time, there were made textural analyses for the loess and loess-like deposits from main regions of the country and stated that the loess from Romania is similar, as concern the mechanical composition, with that from Eastern and Central Europe (Gherghina, Grecu, Cotet, 2006).

The extent of the loess and loess-like deposits in Romania

Many researchers related that the area occupied by the loessoid deposits is about 40.000 km² and is spread on the interfluves and the top of the terraces from pericarpethian regions: the Romanian Plain, Dobrogea, Getic Plateau, Moldavia, the West Plain (Figure 3). To this there are added the loess-like deposits on some terraces or slopes from Subcarpathian Hills, Transilvanian Plateau and some intramontanian depressions (Table 1).

In Romania loess thickness varies from 6 meters in Constanta to a maximum of 60 meters in Tulcea (Table 2)

Table 1. The origin of the loess deposits in Romania according to “THE LOESS FROM ROMANIA IN THE ROMANIAN SPECIALIST VISION” (after Ghergina, Grecu, Cotet).

Area	Geological origin
Eastern Romanian Plain	Aeolian loess proceeded from alluvial meadows.
Central part of the Romanian Plain	Loess and loess-like deposits with different texture and alluvial and proluvial genesis.
Oltenia Plain	Loess-like deposits with loamy texture and complex genesis: deluvial, alluvial and aeolian.
The Getic Plateau	Loess-like deposits with different texture and genesis: deluvial-aeolian on interfluves, deluvial-alluvial on terraces and aeolian on upper terraces.
Dobrogea	Typical loess with paleosoils on interfluves, aeolian origin on southern interfluves, deluvial aeolian on slopes in north and center and eluvial-deluvial on terraces.
Moldavia	Aeolian loess in south, loess-like deposits in Jijia Plain; alluvial loess-like deposits on terraces, loess-like deposits proceeded from marls on interfluves.
The West Plain	At south of the Mures river, aeolian and sandy loess at north of the Mures river.
Transilvanian Plateau, Brasov Depression and Curbura Subcarpatian Hills	Loess-like deposits with different texture and complex genesis: alluvial, proluvial-coluvial and aeolian.

Table 2. Thickness of the loess deposits in Romania (NP 125-2009).

Area	Deposit thickness
Right bank of the Danube (from Ostrov downstream)	30 m
Cernavoda, Tulcea - the left bank of the Borcea arm	40-60 m
Tecuci - Nicorești	50 m
Ialomiței valley – Marculești, Țândărei Turnu Măgurele	30 m
Brăila, Galați	10-35 m
Fetești	25-35 m
Constanța	6-10 m
Giurgiu	6-10 m
Covurlui plain	7 m
Tecuci	7-8 m

CONCLUSIONS

Loess and loess-like sediments cover 10% of Earth's land surfaces, in Europe, loess and loess-like sediments cover almost 1/5 of its total land surface.

Many loess deposits from the eastern and central Europe has been re-deposited by the Danube River and its tributaries.

In Romania the area occupied by the loess and loess-like deposits is about 40.000 km² and is spread on the interfluves and the top of the terraces from pericarpathian regions.

Variations in the source of the loess can be constrained geochemically through the analyses of major and trace elements within the bulk composition.

The researches on loess and loess-like deposits from Romania begun at the end of the XIXth century with paper “Relation sommaire sur la structure geologique dans les jud. de Tutova, Fălciu, Covurlui, Ialomița et Ilfov”, by Gr. Stefanescu. The complex studies achieved in time, at macro- and micro-regional level covered many themes and led to knowledge of the loess and loess-like deposit characteristics and extent.

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