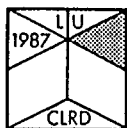


# LOESS LETTER 33

APRIL 1995

ISSN 0110-7658



WHAT DOES YOUR SOCIETY DO?



WE GET TOGETHER AND STUDY.



LL33 April 1995

Loess Letter is the newsletter of the Loess Commission of the International Union for Quaternary Research INQUA. LL33 is a special issue to celebrate the 14th INQUA Congress, Berlin, 3-10 August 1995; if you are at the Congress don't forget to come to the Loess Commission meetings, we have important things to discuss - and decisions to make. There may be a wholesale reshaping of the Commission at 14th INQUA and it is important that you make your views known.

The theme of LL33 is 'Quaternary International'. QI is our INQUA journal; LL33 allows us to show our support for this important journal, and to highlight loess contributions since the 13th Beijing Congress. We reprint titles and abstracts from two loess issues: a geotechnical issue

edited by Drs. Pecs, Derbyshire and Smalley (Q124) and a strategic/South American issue edited by Drs. Zarate, Flegenheimer and Pecs (Q117).

LL is published by the Centre for Loess Research and Documentation, Geography Department, Leicester University, Leicester LE1 7RH, UK. The editor is Ian Smalley - send him your news, comments and loess reprints. Say hello at 14th INQUA; be sure to attend Symposia 54, 55 and 56.



## QUATERNARY INTERNATIONAL

The Journal of the International Union for Quaternary Research

Volume 24 1994

### FAILURE MECHANISMS IN LOESS AND THE EFFECTS OF MOISTURE CONTENT CHANGES ON REMOULDED STRENGTH

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Investigations into the failure mechanisms of loess slopes in the loess region of north-central China have shown that a majority of mass movements are associated with shallow slab slides predominantly moving under tension. The effects of soil-moisture content are of paramount importance: when dry, vertical slopes in loess may exceed 15 m in height, but under conditions close to saturation the structural strength of loess rapidly decreases, causing failure of the slopes. Mass failure of loess occurs as collapse due to hydroconsolidation, and disintegration of the loess fabric as a result of liquefaction or fluidization, and can be associated with progressive failure processes. Local destruction of the openwork fabric of the loess can lead to small 'plastic' movements within the loess deposits. This is as close as loess can

### PHYSICO-MECHANICAL PROPERTIES OF LOESS IN POLAND (STUDIED *IN SITU*)

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The applicability of accuracy of selected field methods in determination of physico-mechanical properties of loess is discussed. The studies were confined to loess in southern Poland and the results pertain to typical loesses forming contiguous covers in upland regions.

The properties of loesses were determined with a pressuremeter, cone penetration test, Swedish weight penetrometer, vane test, and by radiometry. In the course of *in situ* studies, samples with disturbed and undisturbed structure were collected for laboratory determination of physical properties. The usefulness of radioisotopic fluorescence analysis in rapid determination of Ca and Fe contents in loesses is discussed.

New criteria are given for the assessment of the metastable structure of typical loesses, determined on the basis of pressuremeter and radiometric measurements. The metastable loess layers may be approximately identified in the vertical profile on the basis of results of measurements carried out with the Swedish weight penetrometer and those produced by cone penetration and vane tests. The site investigations revealed that loesses with metastable structure most often occur in the considered region at depths of up to 4.0 m.

### ENGINEERING GEOLOGICAL PROBLEMS IN LOESS REGIONS OF HUNGARY

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Throughout Hungary periglacial conditions were widespread in the Pleistocene. As a result, one-third of the country is covered by loess and its subtypes.

From an engineering geological point of view the major problems concerning these areas are the erosion and landslide bluffs and the collapsing of cellars dug in the loess. The length of cellar network in the studied settlements reaches 100 km. The engineering geological studies therefore were concentrated on these two major problems.

From a geological viewpoint the territory of Hungary forms a part of the Carpathian basin surrounded by mountain ranges of the Alps, the Carpathians and the Dinarids. Geomorphologically, the area of the country (93,030 square km) is of basin character, dominated by plains (68.8 per cent), with only limited vertical dissection.

As far as the superficial geological formations are concerned, the loose, clastic deposits of Quaternary age are dominant. Some 43.8 per cent of these are of fluvial origin (including lacustrine and pasudal) and 42.0 per cent are of aeolian origin.

### A LANDSLIDE TYPE OCCURRING FREQUENTLY ALONG THE LOESS BLUFF IN THE HUNGARIAN DANUBE SECTION

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The modes of technical intervention as to landslide prevention may differ depending on landslide types. A slab slide type of mass movement occurs along the bluff of the so-called low-lying loess plateaus which are situated on the medium-elevated alluvial fan surface. The thickness of the loess plateau varies between 40 and 60 m, with the loess, paleosol and sandy strata deposited nearly horizontally. A method of protection against slab landslide is discussed in the present paper.

### CHANGES IN LOESS FABRIC CAUSED BY COLLAPSE: AN EXPERIMENTAL STUDY

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This paper models the collapsibility of loess soils under laboratory conditions and examines fabric changes by scanning electron microscopy. Collapsibility depends on microstructure, and collapsed soils consist of aleurite and psammite grains with clay films. Grain contacts include clay bridges and clay buttresses, which collapse when saturated and loaded. Collapsibility is also affected by porosity (in which pores average about 10 µm), carbonate content, metal oxides and hydroxides and soluble salts.

## THE PLEISTOCENE-HOLOCENE EOLIAN DEPOSITS OF THE SOUTHERN BUENOS AIRES PROVINCE, ARGENTINA: A PRELIMINARY MODEL

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The aim is to reconstruct the sedimentological history of the Late Pleistocene-Holocene eolian deposits of southern Buenos Aires province. Hence, a preliminary model is proposed in order to analyze the different stages of the sedimentological cycle. The deposits include sandy loess, fine sand sheets and dune fields.

The southern Buenos Aires province represents the depositional area, whereas the source and transport environments are located in the northern Patagonian Andes and northern extra-andean Patagonia.

According to the mineralogical characteristics of the material, explosive volcanism is considered the predominant process of particle formation, particularly as generator of pyroclastic deposits which were reworked by different erosive processes (glacial,luvial, eolian). During the Late Glacial Maximum and the Holocene, alluvial deposits which were mainly generated by fluvial erosion of volcanoclastic sedimentary units, were deposited along the floodplains of the Colorado and Negro rivers, including those distal segments located in the emerged offshore platform. The fluvial regime depended upon the regime of the glaciers, hence it reflected the major glacial fluctuations which took place in the Andes. Floodplains were deflated by southwest winds, transporting the material towards the southern Buenos Aires province (sandy loess and loessial sands) and to La Pampa province (dune fields).

## EOENVIRONMENTAL RECONSTRUCTION BY POLLEN ANALYSIS FROM LOESS SEQUENCES OF THE SOUTHEAST OF BUENOS AIRES (ARGENTINA)

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A model of the dynamics of pollen dispersion and deposition in relation to loess deposition is proposed. It is based on pollen analysis of three discontinuous loess sequences of Late Pleistocene-Holocene age, that are located at the archaeological locality Cerro La China, Buenos Aires Province, Argentina (37° 57' S.; 58° 37' W.). Deposition and accumulation of loess and pollen are interpreted in terms of their provenance and transport using the Tauber (1967) and Pye (1987) models for pollen and dust dispersal, respectively. Three pollen zones can be distinguished based on changes in pollen assemblages. The final Late Pleistocene-Early Holocene interval is represented by pollen zone 3. Loess deposits have been accumulated in an environment with a locally high effective moisture. Loess deposition would have occurred synsedimentarily with extra-regional, local and regional pollen taxa. The relationship between pollen dispersal and possible extra-regional pollen sources indicate predominantly W.-SW winds. This zone is truncated by an erosive episode, hence, the successional process of the community could not be reconstructed for the Early Holocene. The Middle Holocene is represented by pollen zone 4. Deposition of loess began in an environment with predominantly herbaceous communities. Pollen concentration increases towards the top of the zone and may represent a buried soil; this would imply a change towards more stable and humid conditions than those at the beginning of the deposition. Extra-regional pollen concentration suggests a comparatively high local and regional pollen productivity rather than a change in wind direction. A slight erosive episode constitutes the upper boundary of zone 4 and is related to new drier conditions. Zone 5 occurs during historical times and is represented by graminous steppe communities and over-representation of local taxa.

## CLAY MINERAL COMPOSITION OF PAMPEAN LOESS (ARGENTINA)

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This paper summarizes current knowledge on clay minerals on the Pleistocene and Holocene pampean loess. Detrital illite is the predominant clay mineral of the vitroclastic loess, with minor amounts of montmorillonite and kaolinite minerals. The illite, with small K content, corresponds to a highly illitic illite-smectite component. In paleosols its crystallinity index decreases and there are more expandable interlayers, as in the Chinese loess.

## SUSCEPTIBILITY TIME SERIES OF THE BAOJI SECTION AND THE BEARINGS ON PALEOCLIMATIC PERIODICITIES IN THE LAST 2.5 Ma

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Magnetic Susceptibility measurements were conducted at 10 cm intervals in the Baoji section, a 160 m thick loess deposit in the southern Loess Plateau. An independent time scale was developed under control of paleomagnetic data by assuming that the eolian dust deposition rate during glacial periods is 1.5 times higher than that during interglacial periods. The 1600 susceptibility results were then plotted to the time scale which has a basal age of 2.5 Ma based on paleomagnetic measurements. Fourier analysis of the susceptibility time series shows strong spectral peaks centered at about 400,000, 100,000, 40,000 and 20,000 years, coinciding with the Milankovitch periods of paleoclimate. The dominant climatic periodicity recorded in the loess section appears as a function of the time interval considered: the 0-0.8 Ma interval is dominated by the period of about 100,000 years, the 0.8-1.6 Ma interval by 40,000 year cycles and the 1.6-2.5 Ma interval also by 100,000 year rhythms.

## TEXTURAL CHARACTERIZATION AND STRATIGRAPHIC ASPECTS OF THE LATE PLEISTOCENE-HOLOCENE EOLIAN SEDIMENTS IN THE SIERRA DE LA VENTANA AREA, BUENOS AIRES PROVINCE, ARGENTINA

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Textural characteristics of Late Pleistocene-Holocene eolian sediments in the Sierra de la Ventana area (Buenos Aires province, Argentina) are defined and compared with loessic sediments from other areas of the province and with the typical loess of the northern hemisphere. These deposits correlate with the stratigraphic units previously established in the study area.

The study was carried out on samples collected with pedological criterion in the less-altered (c) horizon of two profiles. The textural homogeneity which characterizes the sediments of one of the profiles is due to the fact that they were originated on the same parent material. On the other hand, the differences found within the other profile were inherited from the parent materials.

The textural features of the sediments analyzed in the present study show the similarity with the loessic sediments described in Buenos Aires province, and show a greater fine sand content than typical loess of the northern hemisphere. Based on these analyses (without taking into account the calcium carbonate content) the Late Pleistocene-Holocene eolian sediments from Sierra de la Ventana area are classified as loess, sandy loess and eolian silt-clayey sand.

## PALEOSOLS IN LOESS DEPOSITS OF THE ARGENTINE PAMPAS

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Paleosol studies are in their first stages in Argentina. As far as we know, the soil and paleosols correspond to buried Alfisols and Mollisols with hydromorphic and carbonatic features. The paleosol sequences on loess are made up of a succession of B or C horizons which, furthermore, are polygenetic as a result of encroachment of each pedogenesis on the underlying loess mantle. Differences in mineral composition are scarce, with the exception of increases in glass shards and phytoliths in some loess mantles. The b-fabric is mostly stipple-speckled or mosaic-speckled, and microlaminated clay coatings are very common. There are also amorphous features related to voids or to the soil matrix. Evidences of biological activity are present as an excremental fabric on which a fissure microstructure is superimposed. The paleosol sequences consist of several loessoid mantles, each corresponding to a depositional pulse followed by a quiescent pulse, during which pedogenesis took place. Truncation is considered to be due to eolian/fluviatile erosion. Also, there probably are A horizons masked by alteration and pedogenesis. A pedogenetic origin of the calcretes with redeposition in the buried paleosols is assumed.

## LEOSOLS ON LATE CAINOZOIC LOESSIC SEQUENCES IN THE NORTHEASTERN SIDE OF TANDILIA RANGE, BUENOS AIRES, ARGENTINA

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The purpose of this work is to describe and characterize paleosols from Late Cainozoic loessic sequences in the northeastern flank of Tandilia Range. Pedological and non-pedological levels are described, considering the vertical (thickness, color, texture and structure) and horizontal (lateral pattern) development. Mineralogical, grain size, physico-chemical features are analyzed in type profiles.

This study recognizes two groups of paleosols associated with distinct paleoenvironmental conditions: (I) paleosols which are regionally continuous and extensive, related to moisture conditions wetter than the present ones, showing truncated and superimposed profiles; (II) paleosols related to water bodies, showing uneven distribution which are mainly topographically controlled. Sediments that have undergone pedogenesis are identified by their morphological, physico-chemical, textural and mineralogical characteristics and bioturbation features.

The history of pedogenesis and erosion is related to the alternating humid-arid climatic cycles, that have affected the region since the Plio-Pleistocene, to the present.

## BRUNHES-MATUYAMA BOUNDARY IN PLEISTOCENE SEDIMENTS OF BUENOS AIRES PROVINCE, ARGENTINA

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Magneto and lithostratigraphic studies performed in natural outcrops and building excavations in Pleistocene sediments of Buenos Aires Province, indicate the presence of the Brunhes-Matuyama boundary (0.73 Ma) related to one of the Ensenada Formation paleosols. The recognition of sedimentological features related to the Brunhes-Matuyama boundary which are present in almost all the studied sequences, suggests a climatic change during the Brunhes onset.

## IS A MIDDLE PLEISTOCENE CLIMATIC OPTIMUM RECORDED IN THE LOESS-PALAEOSOL SEQUENCES OF EURASIA?

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An attempted correlation of selected Brunhes and uppermost Matuyama silt sequences in Eurasia and a comparison of the successive pedogenic features raises the question of climatic evolution during the Middle Pleistocene interglacial stages.

In the Italian piedmont of the Alps, the strongly developed palaeosols found on the superposed loessic silts show an upward change, particularly clear during Stages 11 and 9, in the characteristics of their Bt horizons. This expresses a progressive shift, during the Brunhes chron, from warm and humid to relatively cooler and drier interglacial conditions. A simultaneous progressive change in palaeosol features is found in the loess sequences of different climatic regions in western and central Europe and in central Asia. This is in marked contrast to the Loess Plateau of central China where the best developed palaeosol (S5-1) correlates with Stage 13.

The existence of S5 has recently been referred to Penck and Brückner's Great Interglacial of the Alps, a classic concept which is, however, clearly contradicted by the loess-palaeosol record in this region. Apart from the Loess Plateau, which may have experienced some regional irregularities in the strength and extent of the summer monsoon, there is no evidence from the loess-palaeosol record to support the occurrence of a Middle Pleistocene climatic optimum in Eurasia.

## DYNAMIC DENUDATION EVOLUTION OF TROPICAL, SUBTROPICAL AND TEMPERATE LANDSCAPES WITH THREE TIERED SOILS: TOWARD A GENERAL THEORY OF LANDSCAPE EVOLUTION

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## THE ARCHAEOLOGICAL RECORD IN PAMPEAN LOESS DEPOSITS

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Archaeological sites in the pampean loess or loess-like deposits of southern Buenos Aires province are discussed. The focus is on site formation processes and the main characteristics acquired by the sites. Pedogenesis and faunal-turbation are considered the most important post-depositional processes which can generate transformations. The environmental conditions did not favor the preservation of organic remains, other than bones and shells. The poor preservation of archaeological features (i.e. floors and pits) is interpreted as a consequence of post-depositional processes, whereas the reduced amount of charcoal and hearths could result from environmental conditions.

## FROM THE LOESS CLIFF TO THE GENTLE SIDE SLOPE: A PREDICTABLE SLOPE EVOLUTION

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Slope stabilization in loess was studied by field observations and measurements with respect to the evolution of gully side-walls in the North American Midwest. Whereas parallel slope retreat appeared to characterize the unstable phase of the slope evolution (the 'gully stage'), after a certain amount of stabilization, the reclining slope retreat was found to be typical during the subsequent 'valley stage' of terrain development. These predictable stages of slope evolution rather strongly determine the nature of gullying and, thereby, affect the various aspects of conservation of the agricultural resources in areas mantled by loess or similar unconsolidated young sediments.

## THE EVIDENCE FOR CAINOZOIC ARIDIFICATION IN SOUTHERN AFRICA

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The Namib and Kalahari deserts preserve evidence of a long history of aridification in southern Africa. The earliest sedimentation within the Kalahari Basin dates to the Late Cretaceous, but the first onset of arid conditions probably occurred in the Early Tertiary; other arid episodes recurred throughout the Tertiary but the development of the Kalahari Sand Sea, with its linear dune system, is unlikely to predate the Late Pliocene. This, the largest single body of aeolian sand in the world, is now largely stabilized by vegetation, but evidence exists for its periodic reactivation throughout the Quaternary.

Although episodes of dune building are evident within the Namib region as early as the Eocene, the Namib Sand Sea, represented by the now consolidated Tsondab Sandstone Formation and the overlying active dunes of the Sossus Sand Formation, does not predate the Upper Miocene. Evidence from the Upper Pleistocene suggests, however, that there were significant fluctuations in the degree of aridity which prevailed during and after the last glacial period.

# FORMATION OF LOESS FABRIC

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Based on studies of the Slovak Carpathian loess soils it appears that the loess mass is composed of various primary rock fragments and minerals, products of their secondary changes and different organic substances. These components are found in loess soils under various conditions. They are diversely distributed horizontally as well as vertically, depending on the relief, the climate, the degree of dissection, the water table level and other factors. The fabric of loess reflects not only the sediment genesis, but affects also its engineering geological properties. For this reason the research reported here attempts to clarify the structures of all lithofacies loess types found in the territory of Slovakia.

## LOESS EROSION ON THE TOKAJ BIG-HILL

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The erosion of the loess mantle of the Tokaj Big-Hill is described on the basis of field observations and surveys as well as laboratory experiments. Above an altitude of 250 m a 0.5 to 0.7 m thick layer of loess has been removed in the last 100 years. Below 250 m linear forms of loess erosion are characteristic, the most striking among them being gullies and inset roads. For a detailed quantitative survey of minor features, the 2-hectare area of the terrace system in the Rákóczi valley was selected. The most common forms were depressions, loess wells and loess sinks.

The laboratory measurements showed that, after higher-intensity rainfalls, sheetwash on the Tokaj loess transports twice as many loess grains than is the case with the forest soil, and the sheetwash impact of low-intensity rain exceeds by almost seven times the value measured on forest soils. Solution erosion is four or five times more intense underground than on the surface. On the solum taken from cultivated loess different values were found: K<sup>+</sup> concentration was particularly high compared to loess under natural conditions. The anomalies in solution erosion are caused by fertilizers and pesticides. The influence of diluted acids on loess structure are presented in electron-microscopic photos. These experiments provide a means of interpreting the evolution of piping in the Rákóczi valley.

Volume 17 1993

## LONG-TERM TERRESTRIAL RECORDS OF THE MIDDLE DANUBIAN BASIN

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In eastern central Europe, in the Middle Danube Basin, loess and loess-like deposits cover various morphotectonic levels in a total area of ca. 150,000 km<sup>2</sup>. Basin types of various elevations and sizes are predominant.

Under different geomorphological or morphotectonic conditions — over an identical time interval — the variation in the rate of basin subsidence produces various litho- and chronostratigraphical sequences.

The subaerial sequence of basins affected by prolonged subsidence in the Quaternary is subdivided by paleosols of larger number than the loess-paleosol sequence of basins, elevated plateaus or watersheds which underwent more moderate subsidence during the Quaternary.

Loess-paleosol-sand sequences on pediments (100–150 m above sea level). In the loess-paleosol-sand sequences of 50–100 m thickness, ca. 12 loess, 10 sand and silt layers and 20–30 paleosols are present. The age of these profiles with hiatuses, is Pliocene–Pleistocene.

Loess-paleosol-sand sequences on alluvial fans and terraces (10–100 m relative heights). The loess sequence is 40–60 m thick and subdivided by 10–12 loess horizons, 10–12 paleosols and 5 or 6 sand layers. LTR — Pliocene–Pleistocene.

Subaerial basin sediment locally of 500–1500 m thickness. The surface of the basin is a flood plain at 90–100 m above sea level. In the basin sediments the number of paleosols may reach one hundred. In several boreholes there are 6–12 red soils or red clays between 600 and 1000 m. 12–16 intercalated sand layers are observed. The age of this almost complete sequence is 5.2–5.4 Ma BP.

In the most intensively subsiding basins sedimentation was almost continuous; during the Pliocene ca. 50–60 and in the Pleistocene ca. 50 soils developed.

In contrast on the non-subsiding foothills only 20–30 soils formed during the Pliocene and Pleistocene and several gaps are detected in the sequence.