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LOESS LETTER 41

RGS-IBG Leicester

TWENTY YEARS OF LL
THIRTY YEARS OF THE INQUA LOESS COMMISSION

IGCP 413

INQUA XV INTERNATIONAL CONGRESS DURBAN 1999

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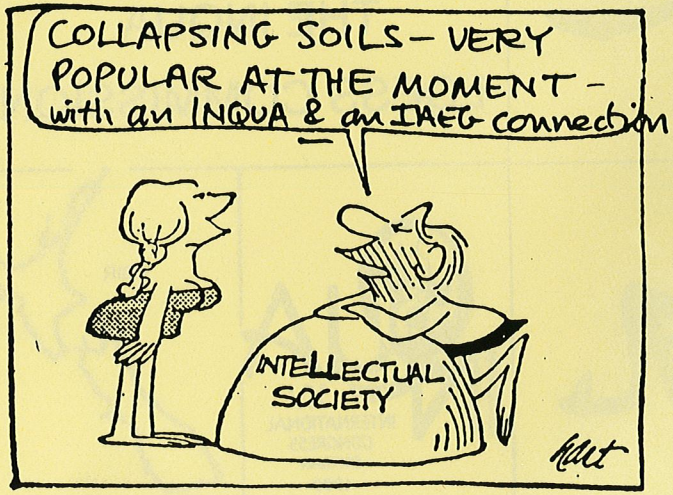
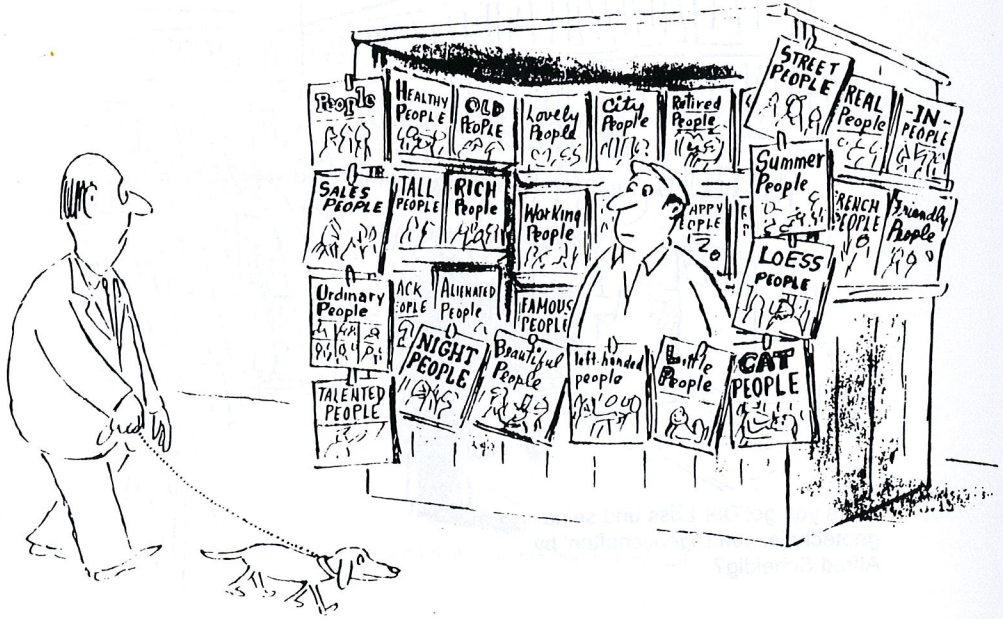


LL41

The symbols on the front cover should be explained. The Chinese title 'Loess Letter'was written for LL by Liu Tung-sheng- we feature it to honour this great loess investigator and to make clear our continuing connection to China and the Chinese loess. China must always be central to the study of loess. Our sponsors and publishers are Nottingham Trent University: to be more precise the GeoHazards Research Group of the Faculty of Construction and the Environment. NTU has been supporting LL since no.35; support for LLs 1-7 came from New Zealand- from the NZ Soil Bureau of the Department of Scientific and Industrial Research. LL was born in NZ twenty years ago and it still carries its original NZ ISSN number to acknowledge its beginning at the Soil Bureau HQ in Taita, near Lower Hutt(long since closed and abandoned as change swept over New Zealand.)

Three conferences are featured on the front: the RGS-IBG meeting in Leicester in January 1999'Geographies of the Future' including the symposium on'Loess Deposits and Loess Soils in Britain(all welcome); the great LoessFest'99 in late March 1999 at Bonn and Heidelberg to celebrate 175 years since Karl Caesar von Leonhard named the European Loess; and the 15th INQUA Congress at Durban in August (Loess Commission & IAEG C18 symposium on'Quaternary Collapsing Soils'). The LoessFest is also a meeting of IGCP 413'Understanding future dryland environmental changes from past dynamics' -we consider our past, but we look to the future. LL sends greetings to delegates at RGS-IBG'99, LoessFest'99 and 15th INQUA- have a good meeting.

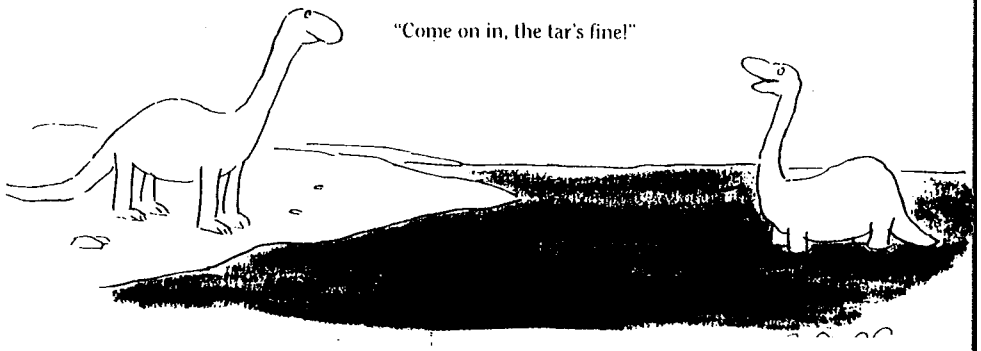


LL is an INQUA newsletter, and we support IGCP(the International Geological Correlation Project of UNESCO & IUGS) and PAGES (the Past Global Changes project of ICSU). LL41 celebrates 20 years of publication; it also celebrates 30 years of the Loess Commission as a Full INQUA Commission(1969-1999) and 175 years of Loess Research.

And- and we welcome new readers from Commission 18 of IAEG- the International Association of Engineering Geology. Commission 18 is the Collapsing Soils Commission, established at the IAEG Congress in Vancouver in September 1998. The major collapsing soil is loess so it makes sense for the Loess Commission and IAEG 18 to work together. LL41 contains papers from the Collapsing Soils section of the Sendai Problem Soils Conference held in October 1998. This conference establishes a sort of Benchmark for future studies of Collapsing Soils, and participants at Sendai will be invited to participate also in C18 activities. The current C18 officers are President: Ian Smalley, Secretary: Ian Jefferson- both at Nottingham Trent University, Faculty of Construction & the Environment. From LL41 this newsletter will serve the Loess Commission and C18, and promote research on Collapsing Soils. The first major joint LC/C18 meeting will be the 'Quaternary Collapsing Soils' symposium at 15th INQUA in Durban S.A. in August 1999. LL42 will be a special issue for this meeting.

Have you got'Der Löss und seine geotechnischen Eigenschaften' by Alfred Scheidig?

A big loess year is coming- make plans to attend the LoessFest, and 15th INQUA, and the Silt Conference at NTU;
and dont forget to check the Loess Letter Online website for the latest Loess/Collapsing Soil information.



Loess Letter Online http://fesweb.ntu.ac.uk/civ/Llo/loess.htm
We are making some progress with LLO- there is a website address. We hope to update it fairly frequently and supply news of whats happening in the world of loess and collapsing soils. The whole LL operation is becoming more electronic and web-based but for the next few years LL and LLO will run together.

GeoEng 2000

Melbourne Convention Centre, Melbourne, Australia

November 19 - 24 2000

http://www.icms.com.au/geoeng2000/home.html

LOESS IN ARGENTINA : TEMPERATE AND TROPICAL

Report on the International Joint Field Meeting of the INQUA Loess Commission and Climates of the Past (CLIP) in Argentina, May 15-21, 1998

This field meeting, organised by Martin Iriondo and his co-workers, went from the heart of the Pampa (Carcaraña basin, Santa Fe province) to the very north-eastern end of Argentina (the Iguazu falls), crossing the provinces of Entre Dos Rios, Corrientes and Misiones. One and half day has been devoted for oral presentations in Parana. Organisation of this meeting was perfect. Martin Iriondo and his co-workers must be thanked for all their efforts. Participants were supplied with detailed, didactic and well arranged field guide books.

The first three days, we toured the pampean loess. Participants unanimously agreed on their typic character, however many problems stand concerning the stratigraphy and the soil forming processes which have affected them. Participants could recognised that studying pampean loess is not an easy task. The Pampa is in fact a huge zone of subsidence in which aeolian materials have accumulated in consequence of which only very shallow sections are visible along river beds, such as along the Carcaraña river. One exception should be mentioned the east bank cliffs of the Parana river in which thick natural sections exist, however with thin loess cover. Consequently pampean loess have to be investigated in quarries which are rather rare. Only two quarries were visited during the excursion, both located west of Rosario city.

In spite of an almost flat landscape, pampean loess sections appear varied and complex. Precise correlations seems to be difficult. Presently only main sedimentary units have been defined for the whole pampean loess belt, moreover they are restricted to the Last Glacial Cycle. Sediments and paleosols dating from isotopic stage 5 have not yet been recognised. Truncations and reworked loess could be observed in the first quarry (Tortugas) while in the second (Carcaraña) loess sedimentation was apparently more progressive, however a discordance was visible in the lower part. Calcium carbonate had aggraded in beds with a nodular morphology (*toscas*) in pampean loess during episodes of the last glacial period while others hardened layers (duripans) are supposed to be cemented by silica.

Geologists and pedologists have a somehow controversial point of view on the Holocene pedo-sedimentary history of the Pampa. Geologists distinguish : (1) during the lower and middle Holocene, the development, on earlier deposited loess, of a paleosol, the Hypsithermal paleosol, which is characterised by an argillic horizon, (2) an aeolian erosion of the Hypsithermal soil around 4000 yr. BP, (3) a present day pedogenesis characterised by a mollic epipedon which is developing on the 4000 yr. BP deflated grey silt. For pedologists, the argillic B and the mollic epipedon belong to a unique soil profile which eventually had experienced Holocene climatic fluctuations. Pedologists consider that the lighter texture of the mollic epipedon results of the process of clay eluviation.

Pampean loess differ largely from Eurasian and Mississippi basin loess, however they have some common characters, calcium carbonate and silica (duripans) accumulations with loess from the western United States (e.g. the Colombia plateau).

In conclusion, further investigations on pampean loess are strongly needed. These loess are the only loess with those of New Zealand from the southern hemisphere. Probably further studies will provide abundant and accurate data. The great thickness of loess supposes a good time span resolution. The wide variety of features present, possibilities of establishing hierarchies between these features will enable precise paleo-environmental reconstructions. However these investigations seem however difficult and expensive. Coring appears necessary to reach sediments and paleosols of the stage isotopic 5 and eventually older sediments. Probably many cores would be necessary because of the stratigraphy variability. Systematic, detailed micromorphological analysis should be performed in order to : (1) detect all the minerals susceptible to trace the origin of the parental materials of these loess, (2) to identify erosional and sedimentary features for reconstructing intensities of erosion and mode of sedimentation and ascertain abrupt events, (3) to recognise pedological features, (4) to establish hierarchy between all present features pedological as well as sedimentary in order to reconstruct sequences of pedo-sedimentary events. Tl dates are already available, however OSL should be preferred to TL. More generally more and more reliable dates are necessary, such as AMS on organic matter of loess and paleosols. Carbon stable isotopes should be tested on secondary calcium carbonates for deciphering environmental conditions of their accretion and on organic matter of loess and paleosols in order to reconstruct the ratio C4/C3 vegetation.

Two and a half days were devoted for the red materials lying on the Cretaceous basalts and sandstones of Corrientes and Misiones provinces which are considered by Martin Iriondo and co-workers to be tropical loess. The recently built, national highway n°14 which runs south to north on the main water divide between Parana and Uruguay rivers offers on hundred of kilometres of magnificent sections. Four of these sections (and a few additional ones) were visited during the excursion. These red materials consist, with only slight variations in thickness, of, from bottom to top : (1) a basalt progressively weathered in kaolinite and ferric oxides, (2) a stone line, (3) a red surficial deposits (10R in the Munsell colour chart).

The proposal of Martin Iriondo and his co-workers to consider this red surficial deposits as tropical loess was intensely discussed. All loess specialists agreed that these red deposits do not fulfil the petrologic criteria for loess. These red deposits for the pedologists are Oxisols merging locally into Ultisols (following the US Soil Taxonomy) which cover huge surfaces in the humid to sub-humid tropics (Brazil, sub-Saharan Africa, Far-East, Australia) on old, stable surfaces. The confrontation between geologists which emphasise on erosional and sedimentary phenomenon and pedologists which consider essentially the soil forming processes, was positive for both. Both agreed that the weathered basalt results of an in-situ supergene weathering of monosiallitic type. Various hypothesis have been proposed for the origin of the stone-line which truncates the weathered basalt. Any of them appears fully satisfactory. The main discussions have concerned the red deposits lying above the stone-line which argentian geologists consider to be wind deposited. A sedimentation by water appears almost impossible because these red deposits occur on top of rounded hills which are frequently on dominant positions on water divides. A correlation between pampean loess and these red deposits is not possible because loess and these deposits are separated by a hiatus of some hundred of kilometres. The Martin Iriondo and co-workers investigations on these questionable tropical loess will undoubtedly force the pedologists to revise theirs concepts on the genesis of Oxisols-Ultisols sequences.

Grignon, July 7, 1998

N. Fedoroff, vice-president of the INQUA Loess Commission

LOESSFEST '99

A conference to mark the 175th anniversary of Von Leonhard's description of the Rhineland loess

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http://www.gg.rhbnc.ac.uk/loessfest

KCvL

PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON PROBLEMATIC SOILS
IS-TOHOKU '98/SENDAI/JAPAN/28-30 OCTOBER

Problematic Soils

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VOLUME 1

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The subsidence of Venice as a collapsing soil problem

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ABSTRACT: Venice is located in the Po Valley, which is constrained by mountains to the north and south-west. Loess material is formed in these mountain environments and deposits accumulate in the valley. This silty material, is classic constituent of collapsing soil systems, forms a significant part of the alluvium that underlies Venice and largely controls the subsidence behaviour. Although aeolian silts are prone to collapse, alluvial redeposition actually prevents collapse because of the much closer packings achieved. The most extraordinary fact about the subsidence of Venice is that it is so modest and slow. It is argued that this is due to the almost immediate collapse of the silty layer, facilitated by a combination of a polydiverse fine grained material (mainly silt and some clay) and a gradually increasing overburden stress, allowing syngenetic dissipation of pore water pressure. Venice has survived this long because of the rapid packing transformations that occurred.

1 INTRODUCTION

Hutchinson (1997) has recently pointed out that the "neglect of the engineering-geological aspects of the Quaternary" has led to losses on earthworks of tens of millions of dollars. Classic examples the neglect of the special qualities of Quaternary ground is the collapse of the Teton Dam in Idaho in 1976 (Smalley & Dijkstra 1991) and the Atommash factory foundation failure in the Rostov region of Russia in 1983 (Jefferson & Smalley 1998). It has been argued that it was the failure to recognise the loess in both of these regions as a special type of ground material that contributed to the ultimate failure in both cases. Thus to understand and hence predict the behaviour of such deposits, knowledge of their special Quaternary nature is fundamental.

To contribute to a complete analysis and assessment of the on-going problem of the subsidence of Venice, it is necessary to consider in detail the characteristics of the Quaternary deposits underlying the city. The study presented in this paper builds on the (essentially finite element) investigations conducted by Lewis & Schrefler (1987). However, the present study will add to their statement that "the settlement is due to the removal of water", by invoking some of Hutchinson's Quaternary engineering geology and considering the role of the Quaternary on the cumulative subsidence of Venice.

2 SUBSIDENCE

2.1 *Overview of the problem*

Three factors are largely responsible for the subsidence of Venice. Two of these factors are natural:

1. Eustatic rise in mean sea level.
2. Land sinking due to natural consolidation of fine-grained deposits in lagoon substrata.

The third factor is man-induced subsidence due to groundwater withdrawal, which must be linked to factor (2).

2.2 *Brief history*

Between the 12th and 18th centuries, the rivers Brenta, Sile, Piare and others which discharged through the Venice lagoon were diverted into extensive canal systems around the lagoon periphery. Before this time, periods of marine transgression and regression alternated throughout the Pleistocene and the river system transported fluvial material (much of it redeposited loess) from the nearby Alpine ice fields resulting in a complex system of interbedded sand, silt and silty-clay sediments. The results from the UNESCO deep borehole VE1 in 1971 (see Ricceri & Butterfield 1974) and earlier deep drilling established that these Quaternary deposits extend to a depth of about 800m beneath Venice. This represents about 2 million years of deposition; about 1m of deposition per 100 years. At this rate of

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The Monte Carlo model of a collapsing soil structure

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ABSTRACT: A major problem encountered with loess deposits is that of structural collapse upon saturation under load, a process known as hydrocollapse. To elucidate this problem at a microstructural level a computer simulation of the soil has been developed using Monte Carlo random number theory. This models the various microstructures encountered with loess, from the initial formation to the development of a metastable structure and ultimately the hydrocollapsed structure. The influence of particle shape and size on the structure and the void ratio are analysed. A physical model has been created in parallel to the computer simulation to act as a validation of the work. The results from the two types of model correspond well, with void ratios of between 1.2 and 1.6 being obtained for the initial structure; 0.9 to 1.1 for the metastable structure; and 0.5 to 0.7 for the hydrocollapsed structure.

1 INTRODUCTION

Loess is an aeolian collapsible soil whose bonded metastable structure is prone to hydrocollapse upon saturation and loading. Such collapses have caused many engineering problems, e.g. the 1976 Teton Dam failure in Idaho, USA (Smalley 1992) and the 1920 Kansu Province earthflow in China (Lin and Wang, 1988). The severe consequences of such events have led to considerable research into the collapse behaviour. Unfortunately, current understanding of this process is still incomplete in certain key areas, e.g. collapse mechanisms and structural formations.

Feda (1995) discusses two approaches to investigating the collapse problem; at a macroscopic and at a microscopic level. Whilst the macroscopic behaviour of loess is of direct significance to subsidence, it is necessary to understand the microscopic nature of the soil to properly utilise the macroscopic information. It is at this single particle level that knowledge is deficient. An understanding of the degree of volume change undergone by loess on hydrocollapse is important in predicting subsidence. Hence, a knowledge of the soil structure and void pathways will aid any stabilisation technique employed. This paper puts forward a computer simulation generated to elucidate the collapsible structure and the corresponding physical testing developed to validate this work.

2 THE INITIAL STRUCTURE MODEL

A program has been written in FORTRAN 77 to simulate the initial formation of a loess deposit (Dibben et al. 1996). The basis of the simulation is the Monte Carlo method invented by Ulam (Ulam, 1991). Smalley has since the early 1960s promoted this method to examine collapse problems, particularly when investigating the packing nature of loess soils (Smalley, 1966). The FORTRAN program developed generates random numbers and positions rectangular blocks at concurrent locations in a two dimensional array to build up an open structure as demonstrated in Figure 1. Blocks of 4:1 width:depth ratio have been chosen as they best represent the typical aspect ratios of the quartz particles (8:5:2) in a two dimensional form (Rogers et al. 1994). A second model has varied the particle width randomly between a maximum and a minimum value.

Figure 2 shows a separate initial structure program written to generate either elliptical or circular particles of variable size. Ellipses were chosen as the mathematical shape that best represents a weathered quartz particle (Dibben et al. 1997). This program uses a real array of up to 1×10^{-7} accuracy in particle placement, thus allowing much smaller particle overlaps. Newton-Raphson iteration is used to find the contact point of two ellipses. Overall, void ratios of between 1.2 and 1.6 correspond to the soil structure in its unstable state (see Table 1).

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Wetting-induced collapsibility of loess and its engineering treatments

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ABSTRACT: Loess spreads about 630,000km² in China. Wetting-induced collapsibility is one of its outstanding characteristics. In some cases, it is very dangerous to foundations of buildings. After analyzing its collapsing characteristics, mechanism, influencing factors and engineering assessing methods, this paper proposed some practical engineering treatments for the collapsibility now mainly used in China.

1 INTRODUCTION

Loess is a kind of special loose terrestrial accumulation in Quaternary period. It spreads widely around the world. Only in China, its distributing area is 635,280km² or so, of which about 60% is covered by collapsible loess. The collapsibility of loess means the property that when it is soaked, it can proceed an additional deformation under pressure of some degree. In China, collapsible loess mainly spreads in the middle course of the Yellow River, and is dominated by Malan loess of later Pleistocene epoch. Typical collapsible loess has following characteristics: gray or light yellow color; particles of silt size as dominant part; even structure without bed; loose texture with huge void and being rich in carbonate.

The wide spreading area and the striking influences to foundations of buildings (e.g. during 1974–1975, 1505 buildings and 30km of sewer were destroyed because of wetting-induced collapse of loess in six provinces of Shan, Gan, Ning, Jing, Qing and Yu) made the study of the collapsibility an important part of that of problematic soils.

2. THE CHARACTERISTICS OF COLLAPSING DEFORMATION OF LOESS

The collapsing deformation of loess shows characteristics of mutation and discontinuity. The curve derived from uniaxial compression test under soaked condition can be divided into three stages, shown in figure 1.

In the figure 1, section a–b means compressive deformation stage of undisturbed loess, showing near-linear elastic feature being restricted by compression law ($\Delta e = a\Delta p$). Section b–c is wetting-induced collapsing stage, in which the deformation is caused by changes of physical state and strength of loess when it is soaked under constant pressure. So the deformation is plastic and is restricted by the Whole Plastic Theory. Section c–d shows consolidation of loess after being saturated, belonging to viscoelastic-plastic deformation and being restricted by the Biot Consolidation Theory.

Figure 2 is a curve showing relationship between collapsibility coefficient (δ_s) and pressure (P). Section o–a of the curve is stage of normal consolidation. Section a–b is stage of initial development of consolidation, in which the value of $d\delta_s/dP$ is nearly constant. When point c is passed, for the restriction of ring sampler, the test sample can not deform laterally. Collapse stops at point d.

3 ANALYSIS OF MECHANISM OF THE COLLAPSIBILITY OF LOESS

There are many different views on mechanism of the collapsibility, including: hypothesis of capillarity, solution of salt, being lack of colloid, wedging of water membrane, theory of being lack of compassion, view of texture and etc. All the views discuss the mechanism either on micro-texture or on the components of loess. So it is essential to analyze the main compositions of loess including texture unit (individual mineral, aggregate and clot), cements (clay particle, organic matter and $CaCO_3$) and pore spaces(huge pore, framework pore and inter-particle pore), for discovering the mechanism of the collapsibility.

There are mainly two linking types among the framework particles, which take roles as textural

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Mechanical properties and bearing capacity of loess in North-west China

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ABSTRACT: Loess spreads widely in north-west China. Besides its characteristics of wetting-induced collapsibility, this kind of problematic soil is different from other clay soils in a sequence of aspects liking compressive deformation, strength of shearing and etc.. The foundation bearing capacity of loess relates closely to its mechanical properties, so it is obviously important to study loess from the two aspects. Combing with the latest research achievements on loess in north-west China, this paper discussed following problems.

1. Compressive deformation properties;
2. Strength of shearing;
3. Unconfined compressive strength;
4. Determining methods of foundation bearing capacity of loess.

1 INTRODUCTION

Loess spreads about 640,000km² in China. It shows a sequence of special engineering geological properties. Besides its specialty of wetting-induced collapsibility, both of the strength of shearing and the unconfined compressive strength are different from those of other clay soils.

2 COMPRESSIVE DEFORMATION OF LOESS

All loess of different time in the Loess Plateau are lacking of compression. Each of their compressibility coefficients shows characteristics of changing with their water content, degree of saturation and test pressure. Lacking of compression mainly appears as that its consolidation yet has not completed under the upper load, and its structural strength is mainly provided by the skeleton effective stress. But when loess is soaked, its compression feature (the collapsibility) would re-appear, and the mechanical properties would change strikingly too. For instance, the compressibility increases and the bearing capacity decreases. For this kind of structural strength, loess generally shows low compressibility and high strength when it is dry, and it lacks of consolidation under low pressure. It is clear that the mechanical properties of loess are mainly related to the water content(table 1), besides they are closely related to the stress level.

1. In natural state, loess is low compressibility soil (except the new loess), and the deeper it is buried, the lower its compressibility is.

2. When loess is saturated, its compressibility increases evidently. Except the loess of Q_1, all that of Q_3, Q^2_2, Q^1_2 appear this trend. Generally under low pressure (100–200kpa or 200–300kpa), the compressibility can increase 7 times, commonly 3–4 times, or at least 2 times; under medium pressure (400–600kpa), increases 2 times; under high pressure (800–1000kpa or 1000–2000kpa), 2–3 times, at least one time. The great differences shown by the compressibility under different states and pressures fully shows the truth of wetting-induced collapsibility.

3. The compressibility coefficient changes with test pressure. Figure 1 shows two typical curves of loess under different states—natural state and saturated state. The striking differences shown by the two curves reveal the meaning of the wetting-induced collapsibility of narrow sense.

Figure 2 shows that, to loess sample with known void ratio and under stable pressure, when its water content is not high, the compressibility is weak while the wetting-induced collapsibility is strong. With the water content increases, the compressibility increases correspondingly, while the collapsibility decreases when the sample is in saturation state, there for the influences on the collapsibility and the compressibility caused by the water content are fully shown.

The compressive deformation parameters are very important in calculating deformation of loess. To

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Genetic types of loess and their engineering geological characteristics

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ABSTRACT: Genesis of loess includes the soil's mass source and the whole process of transportation, deposition and lithogensis. For one hundred years or more, Chinese and foreign scholars have done much in exploring the problem, and have proposed many hypotheses summed up as the following three-eolian, hydromorphic and multi-genetic ones. The paper discussed the distributing laws, identifying marks and the engineering geological properties of loess with different genesis.

1 INTRODUCTION

Loess distributes widely in the world, but it is thickest, most complete, relatively typical and distributes continuously in north-west China. As a kind of special building material and foundational soil, loess is an important studied subject in the civil engineering circles of China. Since 50's, Chinese scholars have achieved remarkable successes in studying loess' genesis, basic properties, collapsibility, stress-strain relation, foundation deformations and bearing capacity as well as the treating methods. But the genesis of loess is still one of the questions being explored and discussed.

The large-scale spreading loess in north-west China shows a belt-distributing principle which changes from sand to silt to clay in particle from west to east. All the changing trends of loess grain, similarity of mineral component and regional difference in mechanical property proved the view of eolian genesis of loess in China. But in some regions liking piedmonts or rolling topographic areas near rivers, there might form talus, alluvial, pluvial and lacustrine loess because of rainwater's adjustment or river's re-transportation. So loess in China is multi-genetic while the wind is the main factor.

2 GENETIC TYPES OF LOESS AND THEIR CHARACTERISTICS

Loess has being deposited in the whole Quaternary period, but there are striking differences in the engineering geological property among the loess of different times. Commonly spreading in the relatively low-laying lands of paleotopography, the loess of the lower Pleistocene epoch shows features of thin thickness, low buried position, relatively striking influence from water, having been litherficated, so it has not very important effects to engineering buildings, though it shows significance in aspect of strata, and its engineering properties have not been studied too much. The studied-achievements on loess mainly focus on that of the period from the middle Pleistocene epoch to the Holocene epoch. The loess of this period can be classified as recently-deposited loess, the Malan loess and the Lishi loess in strata, and also can divided into primary loess and secondary loess in genesis(see table. 1).

Table 1. Classification of loess' strata

Time	Stratum	Genesis	
Q_4	Recently-deposited loess	secondary loess	dominant by hydro-genesis
Q_3	Malan loess	primary loess	dominant by eolian-genesis
Q_2	Lishi loess		

The primary loess is that transported by the wind, that also means the loess in narrow sense. The basic characteristics of this kind of loess are non-bedding, being dominant by silt in particle size (0.05~0.005mm), being rich in carbonate, having huge pores, well-developed vertical joints, color of light yellow or brown-yellow.

The recently-deposited secondary loess is the re-deposited loess transported by the other forces (river, rainwater and gravity, etc.). It shows characteristics

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Hydrocollapse in a model loess soil

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ABSTRACT: A major geotechnical problem in loess soils is hydrocollapse when wetted, leading to subsidence and structural damage. To investigate the fundamental nature of the hydrocollapse process, while controlling the critical variables including particle shape and size, and clay mineral type and proportion, a model soil system has been devised. Open structured metastable samples were made by direct fall of loess dust into oedometer rings. For the tests reported herein, artificial loess samples were created from mixtures of kaolinite powder and silt derived from crushed sand or ballotini (glass balls). The samples were stressed to different levels prior to flooding, and their response was measured. The behaviour of the artificial samples was in all ways similar to that of natural loess. The tests demonstrated that the degree of hydrocollapse is strongly controlled by clay content, the 'optimum' clay content inducing maximum hydrocollapse being influenced strongly by the overburden stress applied.

1 INTRODUCTION

Collapsing soils are widespread (Rogers 1995) and present a continuing geotechnical problem in many parts of the world. Of all the collapsing soils the greatest problem is posed by loess and its most severe manifestation is in those countries which formed the western part of the Soviet Union and China. Ukraine, in particular, is largely covered by collapsing loess ground. Much of the literature is in Russian (e.g. Abelev & Abelev 1968, Krutov 1982) and the most serious recent failure was the structural collapse at the Atommash factory in Volgodonsk, near Rostov in 1983. Krutov (1987) actually proposed a new branch of construction science, mechanics and foundation engineering as applied specifically to collapsible soils. He also pointed to the need for studies of actual soil materials rather than complicated mathematical solutions by approximate methods.

To study the variables involved in the collapse process in loess, a system of physical models has been developed which produce collapse data for a range of compositions and material types. The models were produced using simple airfall techniques. The experimental programme aimed to establish:

- that the airfall laboratory model gave a good representation of the behaviour of natural loess,
- that the 'small clay' model proposed by Rogers et al. (1994) was relevant for collapsing loess ground (in most situations), and
- that very ideal soil models built from ballotini (glass spheres of uniform size) related sufficiently well to reality and to mathematical sphere packing models to provide a possible link between the two.

2 AN AIRFALL MODEL

In studying collapsible soil behaviour in the laboratory the Roscoe (1970) exhortation to work with the simplest possible soil systems has been followed. This is facilitated by the fact that loess can be considered a relatively simple soil system, essentially a mixture of silt-sized primary mineral particles with subsidiary clay. The airfall model was adopted since preliminary experimentation demonstrated that a realistic loess could be constructed in the laboratory, and thus control could be exerted on all the key variables by enabling compositional changes to be made to the material.

The work at Loughborough has involved both undisturbed and remoulded samples of natural loess from Libya and China (see Assallay et al. 1997). In order to examine the behaviour of natural loess under a variety of conditions, washed natural silt particles from the Malan loess deposits in China were tested with varying amounts of clay mineral (kaolinite) addition. The experimental work reported herein concerns two artificial materials: a silt derived from sieved crushed sand (to represent the most angular likely deposit) and ballotini (glass spheres). The particle size distributions of these materials are given in Figure 1.

Both of the artificial materials were mixed with varying proportions of kaolinte powder to create

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Influence of moisture content on strength behavior of loess

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ABSTRACT: The strength behavior of loess depending on its moisture content W under static and cyclic loading was investigated by the UU strain-controlled triaxial tests. A quantitative assessment of the influence of W on the shear resistance was obtained. The shear strength of loess decreases two times with the increase of S, from 0.28 to 0.70. The resistance against liquefaction of loess with W=17% is about two times lower than of loess with W=9%. The fully saturated loess practically does not possess dynamic stability. An attempt for evaluation of shear strength diminution at infinite dynamic impact is made. The longterm vibrodynamic strength of partially saturated loess is about 2.5-3 times lower than its static shear strength c_u, while for fully saturated loess it is about 8 times lower.

I INTRODUCTION

Loess is well known in civil engineering as unfavourable geologic deposit because of its collapse, or sudden decrease in the volume of the voids, occurs as a result of wetting which softens clay bonds and leaches out cementing agents. Thus the emphasis of the geotechnical investigations has been placed so far on the potential for sudden collapse and/or large differential settlements of certain loess ground.

The loess terrain in the Danubian plain (North Bulgaria) have existed for hundreds of millennia under natural moisture regime. Recently, owing to technogenic reasons, they have been receiving enormous quantities of water and a permanent tendency of increasing of the moisture of loess massifs is observed. The wetted loess base, even if no more collapsible, acquire very unstable mechanical behavior - due to the strength diminution with time the bearing capacity decreases considerably. The hazard becomes still greater, when seismic impact is superimposed to the action of the static load. The combination of weaker structural bonds, decreased effective stresses and the developing positive pore pressure (which cannot be dissipated during the short duration of the seismic shock) can provoke a considerable loss of stability. In these cases for evaluation of the ultimate bearing capacity in stability analysis it is necessary to know the variation of shear strength of loess depending on the degree of saturation.

The engineering behavior of wetted and saturated loess has become a problem of particular concern after the Vrantcha earthquake (1977) in Romania and Bulgaria, Strazitza earthquake (1986) in Bulgaria, Hisar earthquake (1989) in Tadjikistan, etc. The damages of the buildings and other structures were much greater in the areas where the loess ground was highly moistened. It is considered that the intensity of seismic impact in the saturated loess terrains is one-two degrees (according to MSK-64) higher than the intensity in dry loess terrains (Ziangirov et al. 1989). Many researchers (Lutenegger & Hallberg 1988; Bally 1988; Gilman & Gilman 1989; etc.) pointed out the hazardous decreasing of the strength of saturated loess and described a lot of cases of strongly deformed and damaged constructions due to loss of bearing capacity of the base.

Meanwhile on the contrary of the dry loess where considerable research of its geotechnical features have been done, the moistened one is much poorer investigated. Some test results concerning the influence of moisture content on the strength parameters of loess are presented by Mustafaev (1979), Kie (1988), Zaretsky (1989), etc. Bally (1988) emphasized the liquefaction susceptibility of the wetted loess which was confirmed by cyclic triaxial tests on saturated undisturbed loess samples. On the basis of vibrational microvane shear tests Efremenko & Voznesensky (1990) made a conclusion that the dynamic shear resistance of loess is 30-50 % less than static one.

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The modelling of foundations built on metastable loess

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ABSTRACT: Hydrocollapse of loess continues to cause major geotechnical problems the world over. Engineers are increasingly using computer models, such as finite element models in design. For loess soils such models are difficult to produce due to the complex nature of the collapse. One method that will help overcome these difficulties, is to consider collapse from a particle packing perspective, for it is the way the particles pack that decides whether a soil is metastable or not. Using this philosophy a Finite Element model using CRISP90 is currently being developed to analyse foundations built on collapsing loess soils. This paper will discuss the development of this model and its validation, which includes the use of an artificial loess soil manufactured in the laboratory. This model material has been shown to reproduce loess behaviour very well and enables a full range of reproducible and repeatable tests to be conducted.

1 INTRODUCTION

Large areas of the earth's crust are covered with loess. For example, around 14 % of the total territory of Russia is covered by loess (Abelev 1988). A great many residential buildings in cities and towns and big industrial enterprises have been erected on loess.

Loess can cause a number of engineering problems, e.g. settlements in excess of one metre occurred in Lanzhou, Gansu in a terrain composed of 12-14m of collapsible loess underlain by saturated sandy deposits after a test pit of 10m by 10m had been flooded (Qian et al. 1988). Problems result because loess undergoes structural collapse and subsidence due to saturation when both the initial dry density and initial water content are low (Dijkstra et al. 1995).

A considerable body of research has been generated to investigate collapse problems. Unfortunately, the results are often variable and difficult to compare directly. To elucidate this problem it is necessary to examine both macroscopic and microscopic aspects of loess collapse (Feda 1995).

Increasingly, numerical models such as finite element (FE) models are used to examine the behaviour of foundations built on soil. However, loess collapse is still causing problems. This paper will describe the combined finite element and physical model approach currently being used to explore this complex problem.

2 THE COLLAPSE PROCESS

Before any models are developed it is first necessary to establish the typical characteristics of loess in general. From this a universal standard can be produced, which can not only aid the validation off any FE models produced but enable the growing body of literature to be better utilised.

2.1 *Mineralogy*

The structure of loess is dominated by 20-63 μ m quartz particles of a 8:5:2 aspect ratio Rogers et al. (1994). Typically, quartz is the most abundant mineral in loess, with feldspar being also present. Of the clay type minerals, mica is more abundant than montmorillonite (average 15%), which is in turn more abundant than illite and kaolinite (average 5%) (Northmore et al. 1996).

2.2 *The collapse mechanism*

Upon deposition, a loose, open structured, metastable soil is formed, composed of quartz particles separated by coatings or aggregates of clay and carbonate particles. In its dry state the structure has significant strength and can withstand high loads.

Upon saturation, however, the bonding disintegrates and a denser structure is achieved by sudden collapse of the soil particles - often known as hydrocollapse. Saturation can occur through infiltration due to pooling of water from above, leakage from

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THE CRITICAL ROLE OF LOESS SOILS IN THE FOOD SUPPLY OF ANCIENT AND MODERN SOCIETIES

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Introduction

About ten percent of the earth's land surface (about 13,000,000 km^2) is covered by loess (Liu et al. 1985) (Figure 1). Extensive deposits of loess occur in China, central and Eastern Europe, especially the Ukraine, Kazakhstan, Uzbekistan; the Great Plains of the U.S. and Canada, the Midwest and Pacific Northwest of the U.S., Alaska and parts of Argentina, Australia, and New Zealand. China's loess (huang tu = yellow soil) occupies 440,000 km^2 plus 560,000 km^2 of redeposited loess, or about 20% of China's arable land.

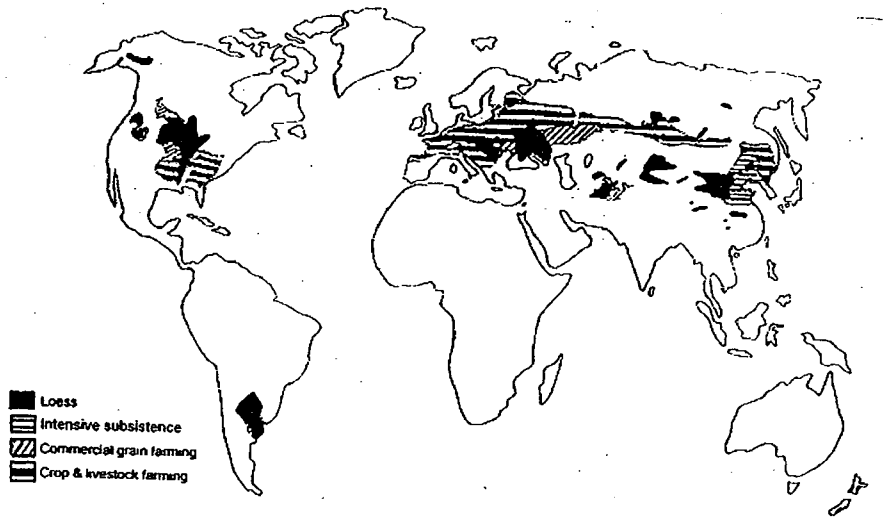

Figure 1. Distribution of major loess deposits of the world with associated cropping systems (after Pye, 1987 and Grigg, 1974).

Characteristics of Some Recent Wind-Lain Dust in North-Western China, and the Interpretation of the Loess Record

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Introduction and Methods

Quaternary loess and modern airborne dust

The great loess sequences of central and eastern Asia are providing some the most detailed terrestrial records of changing climates in the Quaternary. Geological studies of the historical dust storm record, aimed at improving our understanding of the aeolian processes and associated atmospheric systems involved in aeolian dust accumulation, began only relatively recently.

Under present conditions in North China, dust generated by the Siberian-Mongolian-High and the Aleutian-Low pressure systems is frequently transported for long distances. On the western desert margins of the Loess Plateau, dust storms with wind velocities up to 34 m s^{-1} occur, on average, at least once every eight years: during the present decade they have occurred twice (1993 and 1998). The regional transport path (broadly NW-SE) is reflected in the progression across the Loess Plateau from sandy loess to "typical" loess and then clayey loess. This pattern is quite distinct from the long distance transport path in which central Asian dusts are carried several thousand km in the upper Westerlies.

Such observations have relevance to the mode of accumulation of the Quaternary loess: did it accumulate largely during dust storm events or was it deposited, as is frequently assumed, by steady accumulation? Potential differences in the role of dust storms in the accretion of loessic silts in glacial compared to interglacial conditions pose further questions. Another recurrent debate concerns the source or sources of the aeolian silts making up the Loess Plateau. A desert source is strongly favoured by current Chinese research.

Methods

We collected air-fall dust samples at monthly intervals for the four-year period 1988 to 1991 from 8 stations along a 1,000 km transect from both stony (*gobi*) and sand deserts at the western end of the Hexi Corridor, south-eastwards on to the western Loess Plateau. We used dust trays ca. 7 m above ground level at each station. Ground-surface samples were also collected in 1995 at 26 sites distributed along the line of the dust-sampling transect. Laboratory

Desert dust, loess, sand and climatic change – the case of the Negev desert, Israel

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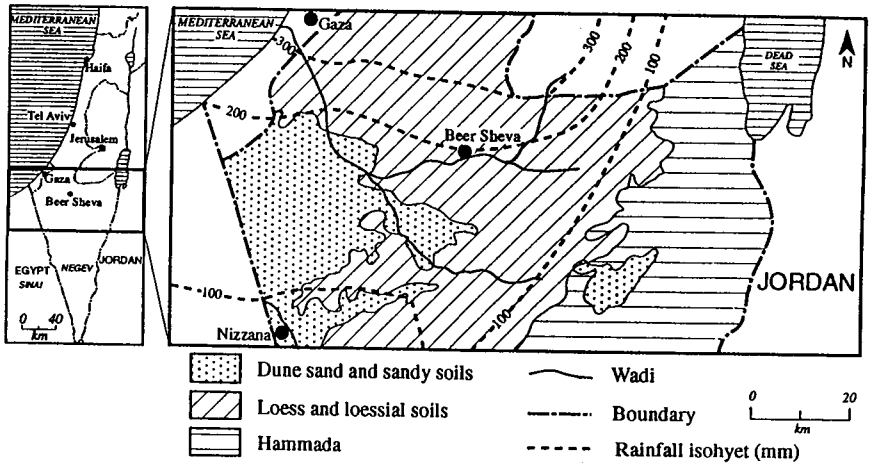
Introduction

Two types of aeolian deposits, loess and sand, cover the northern Negev desert in a transitional climate area where the annual average rainfall decreases from 300 mm in the north to 90 mm in the south. Nearly one third of the 7,000 km^2 of the northern Negev undulating plain is covered by sand dunes and two thirds by loessial soils (Figure 1). The sand dunes represent the eastern end of the Sinai-Negev Sand Sea, extending from the Nile Delta in the west to the northern Negev in the east. The loess exists in the northern Negev only. In all cases the loess underlies the sand, where the two are found in association.



Models of Loess and Sand Deposition in the Negev

Although some researchers regard the loess of the Negev as a fluvial deposit all of the loess is ultimately of aeolian origin, eroded and transported by the wind from the flood deposits of dry wadi (Yaalon and Dan, 1974). There are two mechanisms of loess deposition, one is by dry deposition where vegetation serves as a trap (Tsoar and Pye, 1987), and the other is by wet deposition from dust-laden rainstorms (Ganor, 1975). A combination of the two processes can be taken into account.

The model of Yaalon and Dan (1974) assumes that deposition of loess has been continuous throughout most of the Quaternary. The source of the suspended material is flood deposits from

Use Of Dust In Soil Profiles To Evince Paleoclimate

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Dust and Moisture

In semi-arid to hyperarid regions, where the accumulation of water-insoluble and -soluble eolian dust is important, conditions of soil development exist in a moisture-limited, influx-limited, or balanced state. This is best shown in a moisture-atmospheric dust influx (moisture-dust) diagram, based on a similar diagram of Machette (1985) (Fig. 1). The axes of the moisture-dust diagram are effective moisture, such as MAP (mm yr^{-1}) or leaching index (Arkley, 1963; McFadden, 1982), and atmospheric dust influx, such as mass of dust per unit area per ka. On the basis of the relation between moisture and dust, the states of soil formation are defined by four fields; two fields each in the moisture-limited and influx-limited states (Noller, 1993)(Fig. 1). This diagram does not incorporate weathering processes.

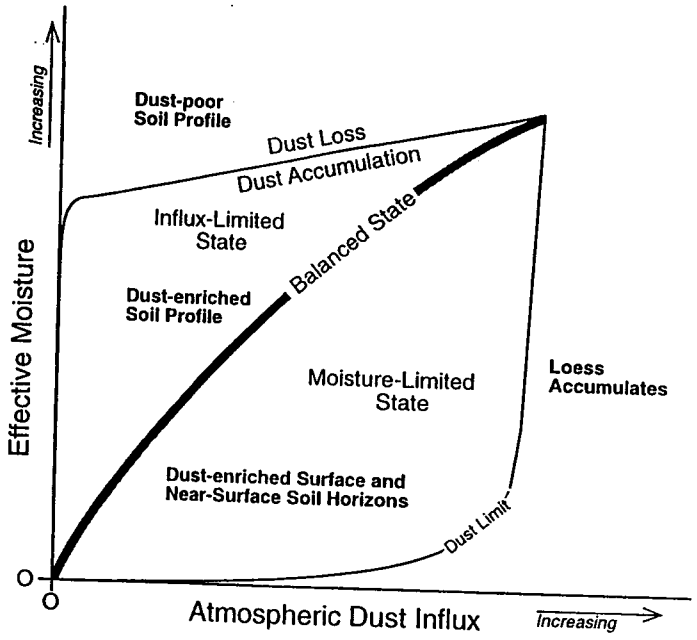

Figure 1. The moisture-dust diagram can be compartmentalized into four fields representing the degree of dust enrichment in soil profiles, and three soil-forming states. Values along the axes are dimensionless (after Machette, 1985; and Noller, 1993).

Abrupt Climate Oscillations in the Loess Record of the Mississippi Valley during the Last Glacial Maximum

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Introduction and Methods

Background

In the summer of 1997, a high-resolution loess stratigraphic record was found in the Middle Mississippi Valley eight miles north of East St. Louis, Illinois. The Keller Farm borrow pit exposes 15 meters of layered fossiliferous Peoria Silt, a loess unit formed during the late Wisconsinan glaciation. About 40 rhythmic beds of loess and paleosols are exposed. Close examination shows that the rhythmic beds represent alternating of paleosol A and C horizons. The dark or redder (humic-iron staining) finer grained zones are A horizons of weakly developed paleosols. The yellowish, carbonate enriched and coarser grained C horizons are less altered loess deposits. Generally, layering is rare in the loess units along the Mississippi Valley because of bioturbation and diagenic, post-depositional changes. However, in our experience, the Keller Farm exposure shows the most complete and best loess-paleosol record of the last glacial maximum ever reported in the Midwest. The layering has a quasi-periodic or rhythmic character from the repetition of soil features and depositional layers. This exposure provides an excellent opportunity to study the effects of fast climatic oscillations during the last glaciation in the middle Mississippi Valley.

Research questions

Millennial scale and shorter climate cycles have been revealed in many geological records. Stable oxygen isotope ratios from Greenland ice cores and ocean sediments have shown that the North Atlantic experienced repeated abrupt climate changes during the last glaciation. The $\delta^{18}O$ values indicate that each cycle represents a relatively warm interstadial and a cold stadial climate. Broecker and Denton (1990) explained this rapid climatic shift as a result of a change in the global pattern of the thermohaline circulation.

Our primary goal is to examine the Keller Farm sequence for morphological and isotopic parameters and their significance. We offer at this point a discussion of our works in progress on stable carbon and oxygen isotopes and radiocarbon dating.

Methods

The outcrop was measured and all morphological boundaries were noted. All color zones appear to be pedogenic and were classified as A or C horizons. Continuous bulk samples were collected at intervals of 10 cm or less. Select carbonate rhizoconcretions were picked out of the samples and analyzed for $\delta^{18}O$ of soil carbonate (SC) and $\delta^{13}Csc$. Spits were analyzed for $\delta^{13}C$ of soil organic matter (SOM) and ^{14}C age, determined on the total humus fraction. Stable isotope analyses follow standard methods.

The $\delta^{18}Osc$ is an accepted proxy for terrestrial paleotemperature and is a direct indicator of the source of meteoric water involved with the formation of SC. SOM gradually accumulates over time from the decomposition of plant materials and remains relative constant over time intervals of decades or longer

Registration of Abrupt Events in Loess

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Introduction and Methods

Loess deposition and paleosol development are classically considered to be long term, progressive events. However Porter and An (1995) reported in the last Chinese loess sequence six abrupt increases of grain size which they correlated with the Henrich events. We have re-investigated under polarizing microscope our set of thin sections from loess sections of China (Malan and Xifeng sections) and of Europe (Achenheim, Alsace and Nauda di Nolle, northern Italy) in order to detect, either attributes present in layers in which these grain size increase occur, or any abrupt changes in features present in loessic materials as in northern Italy. We concentrate our investigations mainly on the transition from the last interglacial paleosol to the first pleniglacial loess which is supposed to date ~ 67000 BP.

Results

The grain size increase detected by Porter and An (1995) appears in thin sections correlated with an abrupt change in the mineralogical composition which consists in : (1) an abrupt appearance of large mica flakes, among which fresh biotite are common, and of calcitic grains, (2) an increase in abundance and in size of heavy minerals, e.g. green hornblende, hypersthene, (3) a few ultra-basic rocks fragments detected only in the Malan section, (4) some isolated and compound fibro-radiated spherules. The abundance and size of charcoal micro-fragments increase also considerably.. All these minerals and charcoal micro-fragments are randomly distributed within the matrix, however a very weak bedding of the mica flakes has been observed in the Malan section.

Anomalies in this transition are not restricted to the grain size composition and the mineralogy. They concern also the microstructure which is fragmented (observed only the Xifeng section) and the microfabric which consists of rounded to subrounded aggregates belonging to the upper horizon of the paleosol. These aggregates are embedded in a fresh loess matrix. In Chinese loess, brownish black, coarse clay coatings are present. At the highest magnification of the polarizing microscope, the brownish black color resolves into very abundant, opaque, micro particles, a few microns in size which could be charcoal microfragments. In Chinese loess, below the transition, in the upper horizon of the paleosol undisturbed phantoms of crystal intergrowths of probably gypsum, or barite, or celestite have been observed.

UCL ECRC

PAGES PAST GLOBAL CHANGES

Royal Holloway University of London CQR

A new molluscan record of monsoon variability over the past 130, 000 yr in the Luochuan loess sequence, China

Denis-Didier Rousseau and Naiqin Wu

This paper presents a new record of monsoon changes that occurred in China over the late Pleistocene. Study of terrestrial mollusks from the loess sequence in Luochuan indicates alternating strengthened summer and winter paleomonsoons. These variations- based on the content of xerophilous, hygrophilous, and oriental species are in very good agreement with the variation inferred from pedology, sedimentology and climate modeling. The three occurrences of currently southeastern species in the sequence indicate that the climate conditions were warmer and wetter than today at about 88, 60, and 10 ka. The main occurrence of xerophilous taxa between 75 and 65 ka is interpreted as drier than today, in agreement with other proxydata. These results demonstrate that fossil terrestrial mollusk data can provide reliable information on past monsoon variability in Asia.

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"Since you conduct only thought-experiments, we were hoping you would, from time to time, come up with some thought-results."

Pedogenic evidence from the Chinese Western Loess Plateau for Asian summer monsoon instability during the past 60,000 years

Xiao-Min Fang, Yugo Ono, Hitoshi Fukusawa, Bao-Tian Pan, Ji-Jun Li, Dong-Hong Guan, Keiichi Oi, Sumiko Tsukamoto and Masayuki Torii

The 28 m Shajinping loess section from the Chinese western Loess Plateau records a 60 ka nearly syn-sedimentary and pedogenic millennial summer monsoon variation. The record shows that Asian summer monsoon experienced rapid episodic pulse enhancements spanning only ca. 1-2 ka in high frequency and having sub-Milankovitch cycles of progressive weakening in low frequency in the last glaciation. Soil formation was in surprisingly fast response to these summer monsoon enhancements, resulting in fairly comparable paleosol sequences. Both the pattern and timing of the summer monsoon enhancements show that they can be well correlated, but with ca. 1 ka lag, to most major warm (Dansgaard-Oeschger) episodes and long-term cooling (Bond) cycles of North Atlantic climatic records, indicating a possible link between tropic oceanic air masses and North Atlantic climatic system. An air circulation model is proposed to interpret this link

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Carbon isotopic composition of organic matter of western European loess sequences

Ch. Hatté, M. Fontugne, P. Antoine, D.D. Rousseau, L. Zöller, N.Tisnérat-Laborde and I. Bentaleb

Loess deposits, amongst other continental records, provide climatic information in spite of the difficulties to establish detailed chronology and correlations with other proxy-data. Vegetation contemporaneous to continental deposits depends on climatic conditions, especially the moisture supply. Changes of vegetation cover are then characterised by variations of carbon isotope ratios ($\delta^{13}C$) of sediment organic matter. Here, we present two high resolution $\delta^{13}C$ records from loess sequences located in the Rhine Valley. Our study shows that past climates in this area were not arid enough to support C4-plants, and demonstrates that organic matter preserved in loess constitutes a reliable proxy-data to study small climatic stresses endured by vegetation over the last glacial-interglacial cycle in north-western Europe. Thus, it appears that major trends recorded by $\delta^{13}C$ of loess organic matter are clearly the result of global atmospheric [CO_2] variations. The rapid events recorded by loess $\delta^{13}C$ results from a high frequency forcing parameter: variations of precipitation distribution linked to fluctuations of polar front location in North-Atlantic. $\delta^{13}C$ variations present a strong correlation with GISP2-$\delta^{18}O$ fluctuations, that record rapid climatic events, especially the warmer so-called Dansgaard-Oeschger events, corresponding to the wettet events in loess sequences. Moreover, using absolute age control and correlations between global climate effects (Vostok-CO_2) or semi-global (GISP2- $\delta^{18}O$), $\delta^{13}C$ of loess organic matter offers a new way to establish a refined chronology in European continental sequences.

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Late Pleistocene climatic variations at Achenheim, France based on a magnetic susceptibility and TL chronology of loess

Denis-Didier Rousseau, Ludwig Zöller, Emmanuel Cocuaud and Jean-Pierre Valet

New field investigations of the Achenheim sequence (Alsace, France 48°35'N 7°38'E) allow for the characterization of variations in the low field magnetic susceptibility (MS) over most of the last climatic cycle, i.e., the last 130,000 yr. New stratigraphy and TL measurements disagree with the previous chronological interpretation of the Upper Pleistocene at Achenheim. Based on a high resolution analysis of MS, the present study shows the occurrence of a "Marker" (fine-grained horizon according to Kukla and Lozek 1961) which was also found recently in another section. The proposed interpretation is that this horizon is characteristic of a small scale dust deposit, prior to the loess deposition itself. This horizon deposited at the marine isotope stage (MIS) boundary 5/4 has been found in other loess sequences and is especially prevalent in Central Europe. It is also indicated by low susceptibility values and a gray color. New TL dates corroborate this interpretation indicating that the loess deposition took place after the MIS 5/4 boundary, i.e. after 70,000 yr. These results are in agreement with the Greenland GRIP dust record which also shows a dusty atmosphere after 72,000 yr. Conversely the present study indicates that the bottom of the sequence is incomplete. On a more global scale, our results from the upper Pleistocene in Achenheim loess sequence show a reliable correlation between the western side of the Eurasian loess belt and the dust record of the Greenland ice cores.

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Sub-millennial scale variations in East Asian monsoon systems recorded by dust deposits from the north-western Chinese loess plateau.

D. Heslop, J. Shaw, J. Bloemendal and E. Parker

Many studies have demonstrated that the magnetic properties of Chinese loess deposits can provide information on the behaviour of the local monsoon regime. However, most work has been carried out in the central parts of the plateau where dust accumulation rates are low and climate induced pedogensis is high,therefore limiting the potential resolution of the available records. A new section from an extremely thick sediment sequence in the north-western part of the plateau (Caoxian village, Gansu Province) appears to give a high resolution magnetic susceptibility record which spans the "Lateglacial" (last glacial/interglacial transition). The record shows several short period climate fluctuations that can be correlated closely to the GISP2 proxy air temperature record. The observed intervals correspond to those more traditionally associated with North Atlantic/European records and include the Holocene amelioration, the Youngest Dryas, the Younger Dryas, the Allerød, the Older Dryas, the Bølling, and the Oldest Dryas. The paleomagnetic directional record obtained from the Caoxian samples demonstrates the additional ability of the loess to act as a recorder of the ambient geomagnetic field and the determined secular variation supports the interpretation of the paleoclimatic data. Although the entire section is 2.25m thick and covers a period of only 12Ka it clearly demonstrates the ability of loess as a high-resolution recorder of local terrestrial climate which may be teleconnected to mechanisms in higher northern latitudes. Loess deposition in China has been continuous since the commencement of the Quaternary, there is therefore the potential to construct a 2Ma-long high-resolution paleoclimatic sequence which could be accurately dated within a magnetostratigraphic chronology.

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Loess Letter 41(20 years of LL) April 1999

Loess Letter LL has been the newsletter of the INQUA Loess Commission for 20 years. It is now also the newsletter of Commission 18'Collapsing Soils' of the IAEG. INQUA is the International Union for Quaternary Research; IAEG is the International Association of Engineering Geology. Both are affiliated to ICSU- the International Council of Scientific Unions which looks after World-Wide science. The Quaternary is the last 2 million years(more or less), and loess is that remarkable wind-blown silt which provides the basis for the best agricultural soils in the world; but also provides widespread and costly collapsing soil problems to worry the construction industry. The two commissions which LL supports promote and encourage research and study on loess in most of its aspects.

Loess stratigraphy provides an excellent terrestrial opportunity to study climate change and the sequence of Quaternary events, and this is a popular research topic within the loess community at the moment(often within the PAGES programme). The engineers tend to focus on subsidence problems and the hazards associated with loess landslides. LL is published twice a year, normally in April and October, by the GeoHazards Research Group in the Faculty of Construction and the Environment at Nottingham Trent University(publication times tend to vary to suit the requirements of relevant conferences). The editors are Ian Jefferson and Ian Smalley(ian.jefferson@ntu.ac.uk & ijs4@le.ac.uk). Send any hard-copy news or announcements to:

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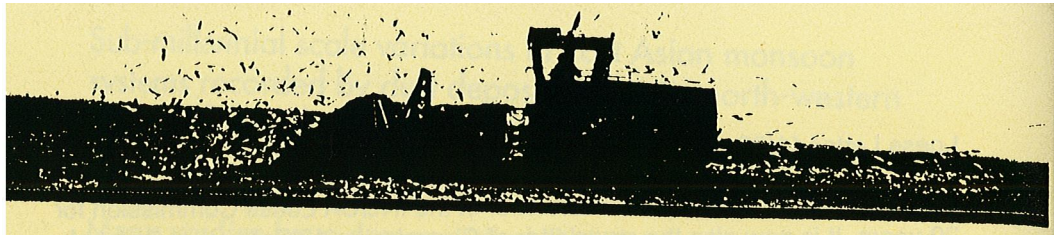

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