TOWARDS A SYNOPSIS OF DATING THE LOESS FROM THE ROMANIAN PLAIN AND DOBROGEA: AUTHORS AND METHODS THROUGH TIME

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«**Loess is not just the accumulation of dust.**»
Márton Pécsi, 1990

Abstract. This tentative synopsis mainly focusses on the aspects of dating the loess - palaeosol sequences in the Romanian Plain and Dobrogea. The approach - placed in a historical framework - is defined by two characteristics. The first part is a short review of important achievements concerning the estimation or evaluation of the loess age, starting ca 120 years ago and ending in 1961. The second part continues with the loess dating history in a comprehensive table systematising significant contributions of the last half-century. Actually, this article has been generated by another paper (under review), dedicated to a conceptual sedimentary model of the loess in the Lower Danube Basin (Jipa, *in press*). The table emphasizes the interest for the loess dating during the last 50 years, and follows the chronological order of contributions. Implicitly, it is remarked the way passed through time in order to know the loess age, *i.e.* from the classic stratigraphy/pedostratigraphy to magnetostratigraphy, astronomically tuned ciclostratigraphy, magnetoclimatology, and up to the multi-proxy approach and optical/luminescence dating. In most of the sections, ages up to 781 ka are determined (the loess - palaeosol horizons are assigned to the Brunhes Chron of the ATNTS20004/ATNTS2012), but the synopsis includes a section from Dobrogea (analysed by the Infrared Stimulated Luminescence/*IRSL* dating method; Bălescu *et al.,* 2003), wherefore the ″estimated geological age" of 800 ka and the *Marine Isotope Stage 20* are mentioned. Moreover, a recent result (Rădan, 2000, updated in 2012 - references therein) for a loess - palaeosol borehole profile (ca 30m thick) from the Romanian Plain points out, according to the palaeomagnetic investigation of the basal part and to the magnetic susceptibility vertical variation along the sampled borehole (40m depth), the possible identification of the Matuyama/Brunhes boundary (0.781 Ma), located at the base of the *MIS 19*. This subject has generated a dispute in the scientific literature on both the Chinese and the European loess. A tentative discussion on the ″observed MBB" (within the loess horizon **L8**) and the ″corrected/true MBB" (placed within the palaeosol **S7**) is done, by comparing our results from the Romanian Plain with data from the Chinese Loess Plateau.

Key words: Lower Danube Basin Loess, Chinese Loess Plateau, loess - palaeosol sequences, loess dating methods, Matuyama/Brunhes boundary, magnetic susceptibility record, magnetostratigraphy, marine oxygen isotope stages, luminescence/optical dating methods, Glacial/Interglacial periods

PROLOGUE

The title of Pécsi's paper published in 1990, namely ″**Loess is not just the accumulation of dust**", which is used as a ″*motto*" of our synthesis on the loess dating, has been a subject of comments for a series of specialists involved in the various and attractive aspects of the loess research. Pécsi (1990), extending a bit the title and saying that the ″*loess is not simply dust carried and deposited by wind*", remarks that the ″*loess as a concept has to satisfy at least 10 criteria*", and that the ″*loessification is determined by environmental conditions*".

After two decades, Smalley *et al*. (2011), paraphrasing Pécsi's article title, publish the paper ″**Loess is [almost totally formed by] the accumulation of dust**", in the same Journal (*Quaternary International*). Referring to Pécsi's arguments, the cited authors remark that the ″*aeolian deposition is at the very heart of loess formation*“, and that ″*the factor of aeolian deposition is so critical that other aspects are relatively unimportant*“.

The dispute around the loess problems and the references to Pécsi's title is going on, so that we find a hot reference to it at the ″*36th General Assembly of DEUQUA*“ (Deutschen Quartärvereinigung), recently held (September 16 - 20, 2012) at the University of Bayreuth (Germany). Thus, Buggle *et al.* (2012), choosing a title in two parts (see References), with the first one identical to Pécsi's paper title, mention with regard to that ″*this phrasal originally refers to the diagenetic processes associated with the transformation of dust into loess*“, and propose a slightly modified version, namely the "**Loess is not just accumulated dust**", considering that ″*this phrasal emphasizes fairly well the relevance of loess for geosciences, especially as archive for past environmental conditions*“.

If we add to these comments - actually awaked by only a paper title (Pécsi, 1990) - the leading question which gives the first part of the recent paper's title of Hambach *et al*. (2012), *i.e*. ″**Asia in Europe ?**“, we have a first, but a wide-range image - defined on the basis of four paper titles - of the many-sided approach and, at the same time, of the expected dispute around the loess problems occurred through the last two decades or so.

Anyway, at the end of the paper a well-defined answer to the challenging question of Hambach *et al*. (2012) will be found, but also a comprehensive explanation for the attention having been excited by Pécsi's assertion, chosen as *motto* of the present paper.

The synopsis is focused on the last half-century, so that the interest on the evolution of the studies on the dating of the loess - palaeosol sequences from the Lower Danube Basin is self-evident.

1. INTRODUCTION

This tentative synopsis has actually appeared as a result of an invitation to compile a table with the main achievements on the loess dating related to the Romanian Plain and Dobrogea. This challenge has came from the author of a paper dedicated to a conceptual sedimentary model of the loess deposits in the Lower Danube Basin (Jipa, *in press*).

Starting from this idea, a systematisation of the major stages established within a historical framework has been carried out at last. The table comprises the names of the authors, the methods used to derive or confirm the age of the loess (**L**) - palaeosol (**S**) sequences, the location of the sections/profiles in the Romanian Plain and Dobrogea, the data about the number of the **L** and/or **S** horizons (according to the local codification) under attention for dating, and finally, the proper age obtained or suggested for the **L** and/or **S** horizons (Table 1). The table refers to the authors in the chronological order of their contributions to the loess age knowledge. At the same time, the reader can easily observe the evolution in time of the methods which have been used for dating the loess - palaeosol sequences in southern Romania.

After a short presentation of the early history of the loess dating in the above mentioned area (starting ca 120 years ago), there is the synopsis "core". This consists of the table structure supported by its main features, having as a guide - over the last half-century - a long series of Romanian authors, but also several foreign ones. Various dating methods were applied, which actually reflect the evolution of the loess investigation since 1961 till present.

Moreover, an updated interpretation of some unpublished results obtained in 2000 with regard to a loess - palaeosol sequence traversed by a geological borehole located at Zimnicea (*ZBhP*; Romanian Plain) (Rădan, 2000, in Enciu *et al*., 2000) is included in the paper as additional data for one of the most important dating methods. This is based on a composite approach: ″magnetic susceptibility (**MS**) stratigraphy“ integrated with ″magnetic polarity stratigraphy“/"magnetostratigraphy“. The correlation of *ZBhP* with the **MS** records for two loess - palaeosol sequences from the *Chinese Loess Plateau*, one of them being calibrated to the ″*marine oxygen isotope stages*“ (*MIS*) of the *benthic* $\delta^{18}O$ *record* at ODP site 677 (Shackleton *et al*., 1990), is presented, as well. The possible identification of the Matuyama/Brunhes Boundary (*MBB*; 781ka ago) within the loess **L8** (the ″*observed*“ *MBB*), and the location of the ″*corrected*“ *MBB* within the palaeosol **S7** of the *ZBhP*, as well as the calibration to *MIS* are commented in the paper and pointed out in the ″*Summary and Conclusions*“.

The last chapter - alongside the conclusions - represents as well a short review of the aspects approached within the synopsis on dating the loess in the Romanian Plain and Dobrogea, based on a comprehensive table and extended by well-documented comments, framed in a regional and worldwide context. An outlook is also included in the last chapter.

2. EARLY HISTORY OF LOESS DATING IN THE ROMANIAN PLAIN AND DOBROGEA

Such a synopsis is not an easy undertaking, as long as it seems that the history of the loess studies in Romania has begun 120 years ago. Murgoci (1910, cited by Conea, 1970) states that descriptions of the "fossil soils" were done in Romania at the end of the XIXth century by Gr. Ştefănescu (1892, 1895), and at the beginning of the XXth century by R. Sevastos (1908); even more, "the age of the loess has been discussed by many geologists, same as in the other countries where this occurs" (Murgoci, 1910, cited by Conea, 1970).

The first scientist who mentions the thick loess layers from *Dobrogea* is an Englishman, Spratt (cited by Conea, 1970), but the first who has correlated them with similar deposits of other countries of Europe, particularly with the loess from Austria basins, is an Austrian, *i.e.* K.F. Peters (1867, cited by Conea, 1970); he refers also to the presence of the red layers.

It is important to remark that after more than 60 years, Brătescu (1934, 1935; cited by Conea, 1970) studied several profiles of ″loess - fossil soils″ situated between Constanța and Eforie. The results obtained by Brătescu over the fourth decade of the previous century are really impressive. Brătescu recognizes ″three typical yellow loesses and the fourth at the base, continued under the water″, and he correlates them with the four Quaternary Glacial periods: *Günz*, *Mindel*, *Riss* and *Würm*. The ″fossil soils″, which separate them, are assigned by Brătescu to the Interglacials, and the ″black earth from the surface is postglacial, contemporaneous″ (Brătescu, 1934, cited by Conea, 1970). Moreover, Conea (1970) adds that Brătescu (1934) distinguishes ″a coloured loess interbedded within the upper loess stage″, which separates into two parts the *Würm Glacial* (*i.e.*, *Würm 1* and *Würm 2)*. Conea (1970) remarks then the great value of the conclusions which Brătescu (1934) has reached, particularly with regard to the description and the interpretation relating to the ″fossil soils″. Anyway, she makes the observation on the progresses recorded in the Quaternary study in the following decades, *e.g.* the insertion of the ″stadial and interstadial subdivisions within the Glacial periods″, as well as of the ″more analytical and more thoughtful research methods″. Some other contributions to the investigation of the loess and ″fossil soil″ deposits from Dobrogea are reviewed by Conea (1970). A synthesis of the researches that were carried out on the ″fossil soils″ from the eastern Dobrogea and a correlation with the existent data for the Central Europe is also performed by Conea (1967, cited by Conea 1970). As regards the northern Dobrogea, Conea (1970) mentions the paper of Grumăzescu and Grumăzescu-Stoicescu (1967), in which the authors have an attempt to date as ″*Mindel - Mindel-Rissian*″ the median ″lutaceous-sandy complex″ of the three lithological complexes identified within the cover of the Quaternary deposits from that area.

Actually, the study of the loess and ″fossil soil″ has begun in the Romanian Plain, where Murgoci and his co-workers, based on a considerable number of boreholes, succeeded to present the first total view on the repartition, origin and the age of the loess in Romania (Conea, 1970). As regards the age, initially, in 1910, Murgoci (cited by Conea, 1970) considers the loess as a Late Pleistocene formation, but afterwards (1920), he assigns the loess to the last two Glacials. The palaeosols are formed in a Mediterranean climate, generally warmer and with a higher humidity, and the loesses in a dry and colder climate. Later, Brătescu (1937, cited by Conea, 1970) considers that in Romania, as in the Central Europe, within a complete profile, the number of ″loess horizons″ can give us information on the number of ″Glacial periods″, while the number of ″fossil soil horizons″ could indicate the number of ″Interglacial periods″. Conea (1970) remarks then the stratigraphic importance given by Brătescu (1937) to the ″fossil soil bands″ and the ″loess horizons″, recommending this criterion, together with the palaeontological and the geographic (with regard to the relative altitudes) criteria, as applicable to dating the age of the terraces.

After a series of references concerning the contributions of the geographers to the investigation of the fossil soils and of the chemists-pedologists to the laboratory studies of the loess, particularly from the Romanian Plain and Dobrogea, Conea (1970) gets on to the period when the hydrology team of the State Committee of Geology, coordinated by E. Liteanu, became involved in the study of the Quaternary deposits. Conea (1970), in her monograph on the loesses from Dobrogea, including however some sub-chapters dedicated to other regions from Romania, mentions various papers published within the 1952 - 1967 interval, in which the authors approach the loess horizons or the ″loessoid deposits″, as well as the ″fossil soils″ from the Romanian Plain. In the conclusions from the end of the Chapter on the ″*Hystory of the researches*″, she emphasizes that ″although the research method in all the studies is more or less the same, the interpretation of the results, in some cases, is totally different. In fact, this reflects two conceptions on the evaluation of the reports between the Glacials and Interglacials, on the one hand, and the deposition of the loess and the fossil soil forming, on the other hand. Several of them - the most part (*some references are given; among them, Conea, 1967*) - assert the conception ... that the loesses from the temperate zone are considered periglacial deposits, corresponding to the Glacials, and the fossil soils to the Interglacials. Others (*some references are given*) assert the conception that the loesses are Interglacial formations and the fossil soils are Glacial formations″.

3. DATING THE LOESS: AUTHORS AND METHODS OVER THE LAST HALF-CENTURY; A TENTATIVE SYNOPSIS

Starting from the works coordinated by E. Liteanu at the State Committee of Geology, more exactly, from his synthesis (published in 1961) on the "loessoid deposits" stratigraphy for three sectors of the Romanian Plain, explicitly referred to by Conea (1970), we move on to our particular way of systematising - within a comprehensive table (Table 1) - the main contributions of the Romanian and foreign authors with regard to dating the loess - palaeosol sequences from the Romanian Plain and Dobrogea.

3.1 A tentative synopsis within a comprehensive table: a short presentation

Actually, the attempt towards a synopsis carried out in a "historical framework", defined by the last half-century, is presented within the table structure, in the order (Table 1): (1) author/year; (2) methods used to derive/confirm the chronostratigraphy/age of the loess/palaeosol horizons; (3) location of profiles/sections; (4) investigated loess - palaeosol sequences; (5) derived/confirmed ages of the loess/palaeosol horizons.

Therefore, in the *column 1* of Table 1, following a chronological order, we start from the contributions of Liteanu (1961), Conea (1969, 1970) and Ghenea & Codarcea (1974), we go on with Rădan *et al*. (1984, 1990), Rădan & Rădan (1984a,b;

1998), Rădan (1998), Rădan (2000, in Enciu *et al*., 2000; updated by Rădan, in 2012 - references therein), Panaiotu *et al*. (2001), Bălescu *et al*. (2003), Buggle *et al*. (2009) and Timar-Gabor *et al*. (2009, 2011), and we arrive at the end at the results of Bălescu *et al*. (2010), Vasiliniuc *et al*. (2011), Bălescu (2012), Fitzsimmons *et al*. (2012) and Buggle *et al*. (2012).

Taking into consideration the methodological point of view (*column 2*, Table 1), particularly with regard to the age determination of the loess - palaeosol sequences, there are several stages to be relieved, *i.e.*: the classic stratigraphy/pedostratigraphy; the palaeogeomagnetic polarity stratigraphy/magnetostratigraphy; the oxygen isotope stratigraphy and the correlation of the magnetic susceptibility variations (with depth) with the benthic oxygen isotope record from ODP Site 677 (situated in the Eastern tropical Pacific; 1^{0}12'N, 83^{0}44'W; Shackleton *et al*., 1990); the astronomically tuned cyclostratigraphy/Mylankovitch cycles; the orbitally tuned SPECMAP (SPECtral MApping Project) oxygen isotope records derived from deep-sea sediments (Martinson *et al*., 1987; Opdyke & Channell, 1996); the palaeopedological – geochemical multiproxy approach (Buggle *et al*., 2012); the luminescence/optical dating [ThermoLuminescence (*TL*); Optical Stimulated Luminescence (*OSL*)/in combination with the single-aliquot regenerative-dose (*SAR*) protocol, *i.e*. the *SAR-OSL* technique; Infrared Stimulated Luminescence (*IRSL*)].

As regards the location of the profiles/sections (*column 3*, Table 1), these are located in both the Romanian Plain and Dobrogea (Fig. 1). Among the main sampling zones for the loess and palaeosol horizons are the following (from west to east; Fig. 1): *Drănic* (**Dn**), *Zimnicea borehole* (**Zm**), *Malu Roşu* (**MR**), *Mostiştea* (**Ms**) (in the *Romanian Plain*), and *Cernavodă* (**Cv**), *Mircea Vodă* (**MV**), *Cuza Vodă* (**CV**), *Nazarcea* (**Nz**), *Popina Isle* (**PIs**; Razelm Lake), *Jurilovca* (**Jv**; northern border of Goloviţa Lake), *Tuzla* (**Tz**), *Costineşti* (**Cs**) (in *Dobrogea*).

It seems (see *column* 4, Table 1) that maximum six loess horizons alternating with six palaeosol horizons have generally been investigated within a section, *e.g.*: *Mircea Vodă*, *Cuza Vodă*, *Nazarcea-Ovidiu*, *Costineşti* (Conea, 1970; Ghenea & Codarcea, 1974; Rădan *et al., 1984*, 1990; Rădan & Rădan, 1984a,b; Ghenea & Rădan, 1993; Buggle *et al*., 2009). Apart from these, there are the following two sections/profiles: (a) *Tuzla* section (Dobrogea; **Tz**, in Fig. 1), where Bălescu *et al*. (2003) mention seven palaeosol complexes (**S1** to **S7**) below the surface soil, and seven interbedded loess horizons (**L1** to **L7**); the expected geological age of **L7** is 800ka (see Table 1), the authors mentioning the *Oxygen Isotope Stage 20* (see Table 1); (b) *F3 - Zimnicea* borehole profile (Romanian Plain; **Zm**, in Fig. 1), in which - within the basal loess (**L8**) of the ca 30 m thick loess-palaeosol sequence (composed by **L1** to **L8** loess horizons, and **S1** to **S7** palaeosol horizons, respectively) -, the *Matuyama/Brunhes boundary* (*MBB*; 781 ka ago) and the *Marine Oxygen Stages* (*MIS*) *19* and *20* were located (Rădan, 2000, in Enciu *et al*., 2000; updated by Rădan, 2012, references therein; see Table 1 and Fig. 2). Additional information is given at the end of this chapter (*i.e*., Ch. 3.3).

Finally, in the *column 5* of the Table 1, the data about the suggested/derived/confirmed ages of the loess and/or palaeosol horizons are inserted, according to the authors and to the various dating methods that have been used over a half-century. Consequently, the loess - palaeosol sequences investigated in the Romanian Plain and Dobrogea, generally the lowermost palaeosol horizon being **PsVI**/**S6** (apart from the "Tuzla section" and the "Zimnicea borehole profile", as shown above), are not older than 781 ka, according to the palaeomagnetic data (Rădan *et al*., 1984; Pagáč, 1990; see Table 1). It means that the primary/Characteristic Remanent Magnetisation (ChRM) identified in the loess and palaeosol samples showed a normal polarity, which was assigned to the *Brunhes Chron* (*C1n*). The *Matuyama-Brunhes* boundary (*MBB* is located at 0.781 Ma, according to the ATNTS2004 and ATNTS2012 of Lourens *et al*., 2004, and of Hilgen *et al*., 2012a,b, respectively) has not been intercepted within the loess - palaeosol sequences with six doublets **L**-**Ps/S**. When the loess horizons **L7** and **L8**, and the palaeosol **S7** are present, the "expected geological age", according to the *Marine Oxygen Isotope Stages* of the *benthic* $\delta^{18}O$ *record*, is 800 ka (Bălescu *et al*., 2003; see Table 1), and consequently, the *MBB* is possibly located (Rădan, 2012, present paper - additional information; also, Table 1 and Fig. 2).

3.2 Luminescence/optical dating methods; first results for the Romanian loess - palaeosol sequences

Some more details are given now with regard to the latest dating methods used - the *luminescence techniques*. It seems the age determination of the Romanian loess - palaeosol deposits by such a methodological tool was performed for the first time by the *thermoluminescence* (*TL*) *technique*, particularly in the Laboratory of the Faculty of Geology, University Marie Curie-Sklodowska, in Lublin (Poland), more than 25 years ago. Therefore, dr. Elizabeth Król, researcher at the Institute of Geophysics of the Polish Academy of Sciences in Warsaw, participated in the international KAPG palaeomagnetic field trip that took place at the loess - palaeosol sequences from Dobrogea, in 1984 (Rădan *et al*., 1984), and collected some palaeosol samples for age determination. Thus, by using the *TL* method, an age of 650ka ± 90ka (E. Król, pers. communic.; Rădan *et al*., 1990) was achieved for the palaeosol horizon **PsVI**, in the Costineşti section.

Actually, the first application of the luminescence method to "loessic sediments" (in the world), involving measurements of the *Thermoluminescence (TL)* signal from polymineral fine grains (Roberts, 2008), was at the beginning of the 1980s, the referred to author citing papers of Wintle (1981) and Liu (1982).

In this worldwide context, it is worth emphasizing once again the *TL* dating approach (firstly, the sampling works) of the palaeosol horizon (**PsVI**) from the *Costineşti section* during the international field trip carried out in 1984, in Romania (Rădan *et al*., 1984). The above mentioned result was published in 1990 (Rădan *et al*., 1990).

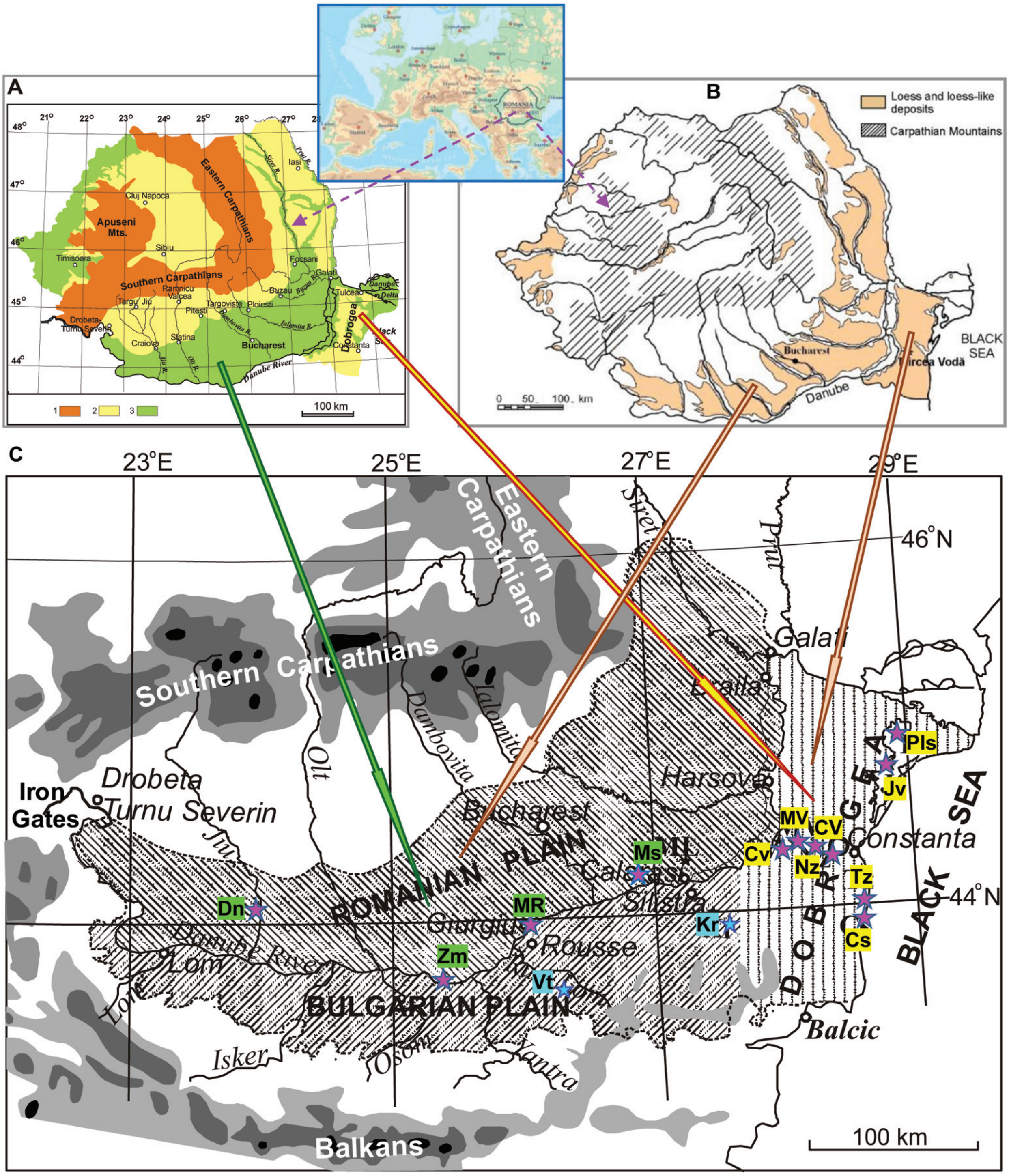

Fig. 1 Location of the most important loess - palaeosol sections in the Romanian Plain and Dobrogea (Romania), which were investigated for dating by different authors through time. **A**. Simplified physical map of Romania. 1 – Highland relief; 2 – Hilly relief; 3 – Lowland relief (after Jipa & Olariu, 2009). **B**. Map showing the distribution of loess and loess-like deposits in Romania (reproduced from Timar-Gabor *et al*., 2011). **A-B** *insertion*: Romania location within Europe (http://www.romaniatourism.com/romania-maps/europe-map.html); **C.** The Lower Danube Plain and its main areal subdivisions. The northern limit of the Romanian Plain, after Conea (1970). The southern Bulgarian Plain boundary, from Fotakieva & Minkov (1966). Location of dating loess sections. a) *Romanian Plain*: **Dn** – Drănic; **Zm** – Zimnicea (borehole); **MR** – Malu Roşu; **Ms** – Mostiştea; b) *Dobrogea*: **Cv** – Cernavodă; **MV** – Mircea Vodă; **CV** – Cuza Vodă; **Nz** – Nazarcea; **Pls** – Popina Isle (Razelm Lake); **Jv** – Jurilovca (Goloviţa Lake); **Tz** – Tuzla; **Cs** – Costineşti (**C** – after Jipa, *in press*, with modifications and additions of some loess section locations). Two more sections (referred to in the text), situated in the Bulgarian Plain (Bulgaria), are marked: **Vt** – Viatovo; **Kr** – Koriten (after Jordanova *et al*., 2007).

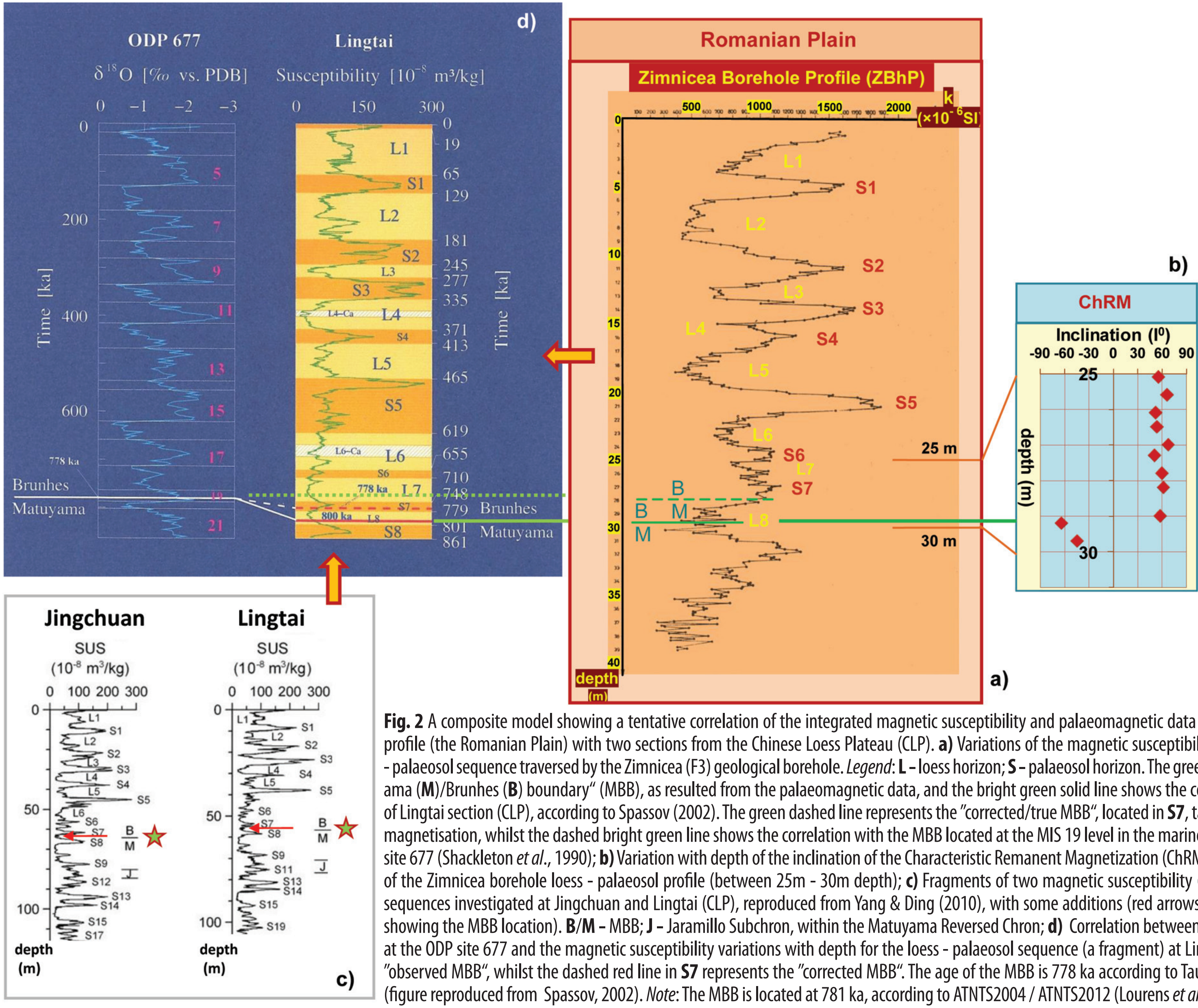

Fig. 2 A composite model showing a tentative correlation of the integrated magnetic susceptibility and palaeomagnetic data obtained for the Zimnicea (F3) borehole profile (the Romanian Plain) with two sections from the Chinese Loess Plateau (CLP). **a)** Variations of the magnetic susceptibility (**k**) with depth recorded for the loess - palaeosol sequence traversed by the Zimnicea (F3) geological borehole. *Legend*: **L** – loess horizon; **S** – palaeosol horizon. The green solid line in **L8** is the "observed Matuyama (**M**)/Brunhes (**B**) boundary" (MBB), as resulted from the palaeomagnetic data, and the bright green solid line shows the correlation with the "observed MBB" in L8 of Lingtai section (CLP), according to Spassov (2002). The green dashed line represents the "corrected/true MBB", located in **S7**, taking into account the delayed remanent magnetisation, whilst the dashed bright green line shows the correlation with the MBB located at the MIS 19 level in the marine oxygen isotope $\delta^{18}O$ record at the ODP site 677 (Shackleton *et al*., 1990); **b)** Variation with depth of the inclination of the Characteristic Remanent Magnetization (ChRM), after thermal cleaning, for a fragment of the Zimnicea borehole loess - palaeosol profile (between 25m - 30m depth); **c)** Fragments of two magnetic susceptibility ("SUS") records for two loess - palaeosol sequences investigated at Jingchuan and Lingtai (CLP), reproduced from Yang & Ding (2010), with some additions (red arrows indicating the loess **L8**, and green stars showing the MBB location). **B/M** – MBB; **J** – Jaramillo Subchron, within the Matuyama Reversed Chron; **d)** Correlation between the marine oxygen isotope $\delta^{18}O$ record at the ODP site 677 and the magnetic susceptibility variations with depth for the loess - palaeosol sequence (a fragment) at Lingtai (CLP). The red solid line in **L8** is the "observed MBB", whilst the dashed red line in **S7** represents the "corrected MBB". The age of the MBB is 778 ka according to Tauxe *et al*. (1996), cited by Spassov (2002) (figure reproduced from Spassov, 2002). *Note*: The MBB is located at 781 ka, according to ATNTS2004 / ATNTS2012 (Lourens *et al*., 2004; Hilgen *et al*., 2012a,b).

Table 1 A tentative synopsis of contributions of Romanian and foreign authors to dating the loess - palaeosol sequences from Romanian Plain and Dobrogea (Romania), over the last half century.

Author/ Year	Methods used to derive/ confirm the loess/palaeosol chronostratigraphy/age	Location of sections/ profiles	Studied loess - palaeosol sequences	Derived/confirmed age of the loess/palaeosol horizons
Liteanu, E. (1961)	Classic stratigraphy ➢ geometrical criteria; ➢ lithological constitution; ➢ palaeontological proofs; ➢ geomorphological arguments	• The Romanian Plain	• "Loessoid-like deposits"	• Middle Pleistocene — Upper Pleistocene — Pleistocene/ Holocene transition • *Mindel Glacial period — Mindel-Riss Interglacial period — Riss — Riss-Würm — Würm —Pleistocene/Holocene transition*
Conea, A. (1969)	Classic stratigraphy ➢ geomorphological analysis of the Quaternary terraces; ➢ lithology and number of loess/ palaeosol horizons accumulated on the terraces (Conea, 1969, cited by Bălescu *et al*., 2003)	• "Loess complex" in Romania	• "Loess complex" in Romania	• The most recent three loess horizons (**L1**, **L2**, **L3**): assigned to the last glacial period (Conea, 1969, cited by Bălescu, 2012); • **S1** and **S2** pedocomplexes: assigned to the last Glacial interstadials (Conea, 1969, cited by Bălescu & Lamothe, 2009 and Bălescu *et al*., 2010)
Conea, A. (1970)	Classic stratigraphy ➢ pedostratigraphical analyses/ palaeopedological studies; ➢ geomorphological information; ➢ lithological data; ➢ physico - chemical analyses; ➢ pollen analyses; ➢ palaeontological studies; ➢ archaeological studies	• Dobrogea *Profiles* (selection): *Ghindăreşti*, *N Dunărea*, *S Dunărea*, *Seimeni*, *N Cernavodă*, *S Cernavodă*, *Rasova*, *Băneasa*, *Almalău*, *Stânca*, *Fântânele*, *Castelu*, *Mamaia*, *Ovidiu*, *Constanța*, *Agigea*, *Costineşti*, *Neptun*, *Comarova* • The Romanian Plain *Profiles*: *Slatina*, *Onceşti - Ghizdaru*, *Pintenu Măgurii (Tinosu)*	• 31 profiles with succession of various numbers of loess and fossil soil alternations	Dobrogea: • An undivided loess (in most cases **W3**); three loess horizons/subdivisions (**W3**, **W2**, **W1**), assigned to *Late Würm*, *Middle and Early Würm Glacial stage*, respectively; a lower loess horizon (possibly, divided into two), assigned to *Riss*; another possible loess layer (older): assigned to *Mindel*; • **GS1**, **GS2** ("soil groups"): assigned to two *Würmian interstadials*; • Soil group **GS3**: assigned to the *Riss - Würm Interglacial*; • **GS4**: assigned to a *Rissian interstadial*; • **GS5**: assigned to the *Mindel - Riss Interglacial*; • **GS6**: *Mindellian interstadials*; • **GS7**: assigned to *Günz -Mindel Interglacial and to older phases of the Lower Pleistocene*
Ghenea, C., Codarcea, V. (1974)	Classic stratigraphy ➢ palaeontological data; ➢ lithological/grain size - mineralogical determinations; ➢ archaeological information	• Dobrogea: *Nazarcea -Ovidiu* (*Nz*) *section* (see Fig. 1C; **Nz**)	• Six palaeosol horizons (**PsI** to **PsVI**), alternating with six loess horizons (**LI** to **LVI**)	• Loess horizons **LI**, **LII**, **LIII**, assigned to the *Würm Glacial Stage*; • The loesses and the palaeosols (**I** to **V** horizons), formed during the last part of the Pleistocene; • The palaeosol horizons **PsV** to **PsI**: the products of the climatic changes taking place within the interval: *Riss - Würm Interglacial - Würm Glacial Stage*; • Palaeolithic tools associated with the Mousterian industry - within the palaeosol horizons **PsIV** and **PsV**: not older than the *Riss - Würm Interglacial*; **PsVI**: possibly, assigned to the *Mindel - Riss Interglacial*
Rădan, S.C., Ghenea, C., Rădan, M. (1984)	➢ Magnetostratigraphic dating/ Palaeogeomagnetic polarity ✓ vertical variation (with depth) of the declination and inclination of the Primary/ Characteristic Remanent Magnetisation (*ChRM*); ✓ vertical variation of the Magnetic Susceptibility (*MS*) and of the Natural Remanent Magnetisation (*NRM*); ➢ Archaeological information	• Dobrogea: *Cernavodă* (*Cv*), *Mircea Vodă* (*MV*), *Cuza Vodă* (*CV*), *Nazarcea* (*Nz*), *Costineşti* (*Cs*) *sections* (see Fig. 1C; **Cv**, **MV**, **CV**, **Nz**, **Cs**)	• Maximum six loess horizons (**L1** to **L6**), alternating with six palaeosol horizons (**PsI** to **PsVI**) (*MV*, *CV*, *Nz*, *Cs*); • Loess deposits only (*Cv*)	• Middle Pleistocene - Upper Pleistocene; • Normal polarity associated with the *Brunhes Chron* (*C1n*): • *Updated* (Rădan, 2012; present paper): Age not older than **781 ka** [according to the correlation to *Brunhes Chron* of *ATNTS2004* (Lourens *et al*., 2004) / *ATNTS2012* (Hilgen *et al*., 2012a,b)]; • The loess from the Cernavodă profile: the upper part of the last glaciation (Ghenea, in Rădan *et al*., 1984)

Author/ Year	Methods used to derive/ confirm the loess/palaeosol chronostratigraphy/age	Location of sections/ profiles	Studied loess - palaeosol sequences	Derived/confirmed age of the loess/palaeosol horizons
Rădan, S.C., Rădan, M. (1984a)	➢ Palaeogeomagnetic polarity/ Magnetostratigrafic method; ✓ vertical variation of the declination and inclination of the Primary/Characteristic Remanent Magnetisation (*ChRM*); ✓ vertical variation of Magnetic Susceptibility (*MS*) and of Natural Remanent Magnetisation (*NRM*); ➢ (Palaeo)geomagnetic polarity dating, integrated within the *Geological map of Romania*, scale 1:50,000 - *Medgidia sheet* (Eds.: Ghenea *et al.*, 1984a)	• Dobrogea: *Nazarcea section* (*Nz*) (see Fig. 1C; **Nz**)	• Six loess horizons (**LI** to **LVI**), alternating with six palaeosol horizons (**PsI** to **PsVI**)	• Middle Pleistocene - Upper Pleistocene; • Normal polarity associated with the *Brunhes Chron* (*C1n*): ➢ *Updated* (Rădan, 2012): Age of the upper part of the lowermost palaeosol (**PsVI**): not older than **781ka** (according to the correlation to *ATNTS2004/ ATNTS2012*)
Rădan, S.C., Rădan, M. (1984b)	➢ Palaeogeomagnetic polarity/ Magnetostratigrafic method ✓ vertical variation of declination and inclination of the Primary/Characteristic Remanent Magnetisation (*ChRM*); ✓ vertical variation of Magnetic Susceptibility (*MS*) and of Natural Remanent Magnetisation (*NRM*); ➢ Palaeogeomagnetic polarity dating, integrated within the *Geological map of Romania*, scale 1:50,000 - *Peştera sheet* (Eds.: Ghenea *et al.*, 1984b)	• Dobrogea: *Mircea Vodă (MV) section* (see Fig. 1C; **MV**)	• A sequence of six loess horizons (**LI** to **LVI**), alternating with six palaeosol horizons (**PsI** to **PsVI**)	• Middle Pleistocene - Upper Pleistocene; • Normal polarity associated with the *Brunhes Chron*; ➢ *Updated* (Rădan, 2012): Age of the central part of the lowermost loess investigated (**LVI**): not older than **781ka** (according to the correlation to *ATNTS2004/ATNTS2012*)
Rădan, S.C., Ghenea, C., Rădan, M. (1990)	➢ Palaeogeomagnetic polarity/ Magnetostratigraphic method ✓ vertical variation of declination and inclination of the Primary/Characteristic Remanent Magnetisation (*ChRM*); ✓ vertical variation of Magnetic Susceptibility (*MS*) and of Natural Remanent Magnetisation (*NRM*); ➢ Archaeological information;	• Dobrogea: *Cernavodă* (*Cv*), *Mircea Vodă* (*MV*), *Cuza Vodă* (*CV*), *Nazarcea* (*Nz*), *Costineşti* (*Cs*), *sections* (see Fig. 1C; **Cv**, **MV**, **CV**, **Nz**, **Cs**)	• Maximum six loess horizons (**LI** to **LVI**), alternating with six palaeosol horizons (**PsI** to **PsVI**)	• Middle Pleistocene - Upper Pleistocene; • The loess deposits from the Cernavodă profile: upper part of the last glaciation; • Normal polarity associated with the *Brunhes Chron*; • *Updated* (Rădan, 2012): age of the loess and palaeosol horizons (**LI** to **LVI**; **PsI** to **PsVI**): not older than **781 ka** (according to the correlation to the *Brunhes Chron* of *ATNTS2004/ ATNTS2012*);
Król, E. (in Rădan *et al.*, 1990)	➢ Thermoluminescence (*TL*) dating			• **650ka±90ka**: the lowermost palaeosol horizon (**PsVI**) - *Costineşti section*
Pagáč, P. (1990)	➢ Palaeomagnetic/ Magnetic polarity method	• Dobrogea: ✓ *Costineşti* (*Cs*) ✓ *Cernavodă* (*Cv*) profiles (see Fig. 1C; **Cs** and **Cv**)	• Three loess (**L3**, **L4**, **L6**) and four palaeosol (**S3**, **S4**, **S5**, **S6**) horizons investigated (*Cs profile*); • Loess deposits (*Cv profile*)	• Middle Pleistocene - Upper Pleistocene; • Only normal polarity along the two fragments investigated within the two profiles (*Cs* and *Cv*)
Ghenea, C., Rădan, S.C. (1993), *updated* by Rădan (2012; present paper)	➢ Palaeogeomagnetic polarity/ Magnetostratigraphic method ✓ vertical variation of declination and inclination of the Primary/ Characteristic Remanent Magnetisation (*ChRM*); ✓ vertical variation of Magnetic Susceptibility (*MS*) and of Natural Remanent Magnetisation (*NRM*);	• Dobrogea: ✓ *Costineşti* (*Cs*) section; ✓ *Nazarcea-Ovidiu* (*Nz*) section (see Fig. 1C; **Cs** and **Nz**)	• Six loess horizons (**LI** to **LVI**), alternating with six palaeosol horizons (**PsI** to **PsVI**)	• Middle Pleistocene - Upper Pleistocene; • Normal polarity only, identified in the two sections (*Cs*, *Nz*), associated with the *Brunhes Chron*; • Age not older than **730 ka** [according to the *Pliocene - Pleistocene Geomagnetic Polarity Time Scale* of Mankinen and Dalrymple (1979), in Butler (1992)]; *Updated* by Rădan (2012; present paper) : the *Matuyama / Brunhes* boundary - **781 ka** (according to *ATNTS2004/ATNTS2012*);
Król, E. (in Rădan *et al.*, 1990)	➢ Thermoluminescence (*TL*) dating			• **650ka±90ka**, **PsVI** - the lowermost paleosol horizon (**PsVI** - *Costinesti section*)

Author/ Year	Methods used to derive/ confirm the loess/palaeosol chronostratigraphy/age	Location of sections/ profiles	Studied loess - palaeosol sequences	Derived/confirmed age of the loess/palaeosol horizons
Rădan, S.C. (1998); Rădan & Rădan (1998)	➢ (Palaeo)geomagnetic polarity/ Magnetostratigraphic method	• Dobrogea: ✓ *Cernavodă* (*Cv*), *Mircea Vodă* (*MV*), *Cuza Vodă* (*CV*), *Nazarcea* (*Nz*), *Costineşti* (*Cs*) *sections*; ✓ *Popina Isle* (*Pls*) - northern Razelm Lake; ✓ *Jurilovca* (*Jv*) - northern border of Goloviţa Lake; • The Romanian Plain: *Drănic* (*Dn*) *section* (see Fig. 1C; **Dn**, **Cv**, **MV**, **CV**, **Nz**, **Cs**, **Pls**, **Jv**)	• Maximum six loess horizons (**LI** to **LVI**), alternating with six palaeosol horizons (**PsI** to **PsVI**) (*MV*, *CV*, *Nz*, *Cs*); • Only loess deposits (*Dn*, *Cv*, *Pls*, *Jv*)	• Middle Pleistocene - Upper Pleistocene; • Age of all the investigated loess and palaeosol horizons: not older than **781 ka** (according to the correlation to *Brunhes Chron*; A*TNTS2004*/ *ATNTS2012*); • The loess from the *Cernavodă* section: upper part of the last glaciation (Ghenea, 1984, in Rădan *et al*., 1984)
Rădan (2000), in Enciu *et al*. (2000), *updated* by Rădan (2012; present paper)	➢ Rock-magnetic method; ✓ vertical variation (with depth) of the magnetic susceptibility (*MS*); ✓ anisotropy of magnetic susceptibility (*AMS*); ➢ (Palaeo)geomagnetic polarity/ Magnetostratigraphic method ➢ Correlation to the magnetic susceptibility variations with depth, with the magnetostratigraphic data and with the benthic $\delta^{18}O$ record of *ODP site* record (Shackleton *et al*., 1990), in the Lingtai loess - palaeosol section from the Chinese Loess Plateau (Yang and Ding, 2010; Spassov, 2002), and with other (palaeo) magnetic signatures recovered, *e.g*., from sections in Bulgaria and Serbia	• The Romanian Plain: ✓ *F3-Zimnicea* geological borehole profile (*ZBhP*) (see Fig. 1C; **Zm**)	• A tentative structure of the loess - palaeosol sequence of ca 30m thickness, traversed by a geological borehole, supported by the magnetic susceptibility variations with depth, is referred to an alternance of 8 loess/loess-like (**L1** to **L8**) and 7 palaeosol (**S1** to **S7**) horizons; still a possible palaeosol horizon (**S8**?)	• Middle Pleistocene - Upper Pleistocene, from ca 29 m (and ca 28m, respectively) borehole depth upwards, and Lower Pleistocene, from that depth downwards (up to ca 39m depth at least - the base of the investigated borehole): according to the "observed", and "corrected/true", respectively, Matuyama / Brunhes boundary (*MBB*) location (*MBB*: dated at **0.781 Ma**; ATNTS2004/ATNTS 2012) (see the paper text and Fig. 2); • The analysed loess - palaeosol sequence was deposited during a time interval ending with *MIS 20* - **L8** (possibly *MIS 21* - **S8**?); ✓ the "corrected *MBB*" (placed within **S7**, lower part) is coincident with the base of *MIS 19*, confirming the data of Shackleton *et al*. (1990); ✓ a very good correlation/equivalence of the *ZBhP* with the magnetic susceptibility record at Lingtai and Jingchuan (Chinese Loess Plateau), and with the "observed", and the "corrected", respectively, *MBB*" location in these two sections (within **L8**, and lower part of **S7**, respectively); • The studied loess - palaeosol borehole profile (*ZBhP*) spans **800ka**, at least.
Panaiotu, C.G., Panaiotu, C.E., Grama, A., Necula, C. (2001)	➢ Rock-magnetic method: ✓ Vertical variation (with depth) of several rock magnetic parameters: low frequency susceptibility (χ_{lf}), Isothermal Remanent Magnetisation (IRM_{200mT}), Anhysteretic Remanent Magnetisation (ARM_{100mT}), frequency-dependent susceptibility (χ_{fd} %), ratio ARM/ IRM. ➢ Correlation of susceptibility variation in the Mostiştea profile with similar values recorded from the loess -palaeosol sections at "Koriten" - Bulgaria (Jordanova & Petersen, 1999) and "Packs" (Hungary; Sartori *et al*., 1999, cited by Panaiotu *et al*., 2001); ➢ Correlation of susceptibility variation with the astronomically tuned marine $\delta^{18}O$ record from ODP 677 site	• The Romanian Plain: *Mostiştea profile (Ms)* (see Fig. 1C; **Ms**)	• Four loess horizons (**L1** to **L4**), three interbedded palaeosol complexes (**S1**to **S3**) and a recent soil at the top (**S0**)	• Paleosol **S1**: correlated with the Interglacial interval corresponding to *isotope stage 5*; **S2**: correlated with the Interglacial interval corresponding to *isotope stage 7*; **S3**: correlated with the Interglacial interval corresponding to *isotope stage 9*; • The loess horizons correlate with corresponding Glacial intervals; • Maximum age of the studied profile at *Mostiştea Lake*: probably, less than **0.4 Ma**

Author/ Year	Methods used to derive/ confirm the loess/palaeosol chronostratigraphy/age	Location of sections/ profiles	Studied loess - palaeosol sequences	Derived/confirmed age of the loess/palaeosol horizons
Bălescu, S., Lamothe, M., Mercier, N., Huot, S., Bălteanu, D., Billard, A., Hus, J. (2003)	➢ Infrared Stimulated Luminescence (*IRSL*) dating method, using: ✓ multiple aliquot additive *γ* dose technique (*MA*) on multigrain aliquots; ✓ single-aliquot regenerative-β dose (*SAR*) method on very small aliquots; ✓ three protocols of age correction for the observed fading	Dobrogea: • *Tuzla/Tz* (Black Sea Shore); The Romanian Plain: • *Giurgiu* (*Malu-Roşu/ MR*) (see Fig. 1C; **MR**, **Tz**)	• Seven palaeosol complexes (**S1** to **S7**) below the surface soil, and seven interbedded loess horizons (**L1** to **L7**)	• Middle and Upper Pleistocene; ➢ *Malu Roşu profile* (*MR*) ✓ a sample collected 20 cm below the Upper Palaeolithic occupation level: Upper Pleistocene; corrected *IRSL* age: 30±4 ka; expected geological age: > 22,790±120 years; > 21,140±130 years ➢ *Tuzla section* (*Tz*) • **L1**: ✓corrected *IRSL* age: 51±5 ka; 52±5 ka; *GLSL age*: 63±8 ka; ✓ expected geological age: *O I Stage 4*; • **L2**: corrected *IRSL* age: > 140±22 ka; 163±23ka; 176±25 ka; expected geological age: *O I Stage 6* (130-200ka); • **L3**: corrected *IRSL* age: > 218±42ka; 250±43ka; 267±46ka; expected geological age: *O I Stage 8* (250-300ka); • **L7** (lowermost loess horizon of *Tuzla section*): ✓ expected geological age: *O I Stage 20* (**800 ka**)
Panaiotu, C.E., Bălescu, S., Lamothe, M., Panaiotu, C.G., Necula, C., Grama, A. (2004)	➢ Rock-magnetic method; ➢ Sedimentological and clay mineral analyses; ➢ Astronomical calibration by tuning the magnetic parameters with the insolation and eccentricity curves (following the method of Heslop *et al.*, 2000); ➢ Infrared Stimulated Luminescence (*IRSL*) dating method	The Romanian Plain: • *Mostiştea/Ms* (see Fig. 1C; **Ms**)	• Four loess layers (**L1** to **L4**), two chernozem palaeosols (**S1**, **S2**) and two brown-reddish palaeosols (**S3**, **S4**)	• **S1**, **S2**, **S3**: interglacial palaeosols; • **L1** (lower part) was deposited during *MIS 4*; • **L2**: during *MIS 6*; • **L3**: during *MIS 8*; • The maximum age of the section (**Ms**) is around **400 ka**; • Entire section (**Ms**) was accumulated during a period within the *Bruhnes chron*
Necula, C., Panaiotu, C. (2008)	➢ Dynamic programming method: ✓ tuning magnetic susceptibility to: - the 65°N summer insolation record; - the stack of 57 globally distributed benthic $\delta^{18}O$ records	The Romanian Plain : • *Mostiştea (Ms) profile* (on the border of the Mostiştea Lake) (see Fig. 1C; **Ms**)	• Four loess horizons (**L1** to **L4**), three interbedded palaeosols (**S1** to **S3**) and a recent soil (**S0**)	• The age of the loess - palaeosol sequence (*Ms section)*: around **433 ka**; • **S1** matches with *MIS 5*; • **S2** matches with *MIS 7*; • **S3** matches with *MIS 9*; • **S4** matches with *MIS 11*
Buggle, B., Hambach, U., Glaser, B., Gerasimenko, N., Marković, S., Glaser, I., Zöller, L. (2009)	➢ Palaeopedology/ Pedostratigraphy; ➢ Correlations of the magnetic susceptibility curves recorded for the investigated loess - palaeosol profiles with the astronomically tuned stacked records of Lingtai and Zhaojiachuan "stratotype sections" from the Chinese Loess Plateau (Sun *et al.*, 2006); ➢ Correlations of the magnetic susceptibility records with the $\delta^{18}O$ record of benthic foraminifera of ODP 677 (situated in the Eastern tropical Pacific; 1⁰12′ N, 83⁰44′ W; Shackleton *et al.*, 1990), as proxy for the global ice volume; ➢ Validation of the obtained chronostratigraphy against existing chronostratigraphic models of other loess - palaeosol sequences in the region (Serbia, Bulgaria, Romania, Ukraine)	Dobrogea: • *Mircea Vodă* (*MV*); The Romanian Plain : • *Mostiştea* (*Ms*) (see Fig. 1C; **Ms**, **MV**)	• Six palaeosol horizons/ pedocomplexes (**S1** to **S6**), alternating with six loess horizons (**L1** to **L6**): **MV** section; • Three palaeosol horizons (**S1** to **S3**) and four loess horizons (**L1** to **L4**): **Ms** section	• **S1** unit is assigned to *Marine Isotope Stage MIS 5*; • **S2** pedocomplex is correlated with *MIS 7*; • **S3** pedocomplex is assigned to *MIS 9*; • **S4** is correlated with *MIS 11*; • **S5** palaeosol may serve as a marker horizon for *MIS 13 –15*, in the area (Buggle *et al.*, 2009); • **L6** is assigned to *MIS 16*; • The oldest soil **S6** is correlated at least to *Marine Isotope Stage* (*MIS*) *17* (interglacial); **S6** (**MV**) is rather correlated with the Chinese **S6** (Buggle *et al.*, 2009); **MV** section: an age around **700ka**

Author/ Year	Methods used to derive/ confirm the loess/palaeosol chronostratigraphy/age	Location of sections/ profiles	Studied loess - palaeosol sequences	Derived/confirmed age of the loess/palaeosol horizons
Bălescu, E., Lamothe, M. (2009)	➢ Infrared Stimulated Luminescence (*IRSL*) dating method, using ✓ the multiple aliquot γ dose technique; ✓ the *IRSL* ages, corrected by using the protocol of Mejdahl (1988; cited by Bălescu and Lamothe, 2009)	Dobrogea: • *Tuzla/Tz* (Black Sea Shore); • *Mircea Vodă* (*MV*) The Romanian Plain: • *Mostiştea* (*Ms*) (see Fig. 1C; **Ms**, **MV**, **Tz**)	• Four to seven loess horizons (**L1** to **L7**, downwards), alternating with palaeosol horizons (**S1** to **S7**)	• The three upper loess horizons (**L1**, **L2**, **L3**), assigned to the last three Pleistocene glaciations (*MIS 2* to *4*, *MIS 6*, *MIS 8*); • The last Interglacial soil (*MIS 5e*) corresponds to paleosol **S1**; • First chernozem soil horizon (*i.e.*, paleosol **S2**), formed during *MIS 7*
Timar-Gabor, A., Vasiliniuc, S., Vandenberghe, D.A.G., Cosma, C. (2009)	➢ Optical Stimulated Luminescence (*OSL*) method	Dobrogea: • *Mircea Vodă* (*MV*); • *Costinesti* (*Cs*); The Romanian Plain: • *Mostiştea* (*Ms*) (see Fig. 1C; **Ms**, **MV**, **Cs**)	• **MV** section: Five palaeosols (**S1** to **S5**), recent topsoil (**S0**) and the interbedded loess horizons; • **Cs** section: investigated - **L1** and **L2**; • **Ms** section: investigated - **L1**, **S1**, **L2**	• Uppermost soil horizon (**S1**): formed during the last Interglacial
Bălescu, S., Lamothe, M., Panaiotu , C.E., Panaiotu, C.G. (2010)	➢ Infrared Stimulated Luminescence (*IRSL*) dating method	The Romanian Plain: • *Mostiştea (Ms) section*; Dobrogea: • *Mircea Vodă section* (*MV*) (see Fig. 1C; **Ms**, **MV**)	• **L1**, **L2**, **L3** loess horizons; • **S1**, **S2** pedocomplexes	• **L1**, **L2**, **L3** are assigned to the last three Pleistocene glaciations *MIS 2* to *4*, *MIS 6* and *MIS 8*, respectively; • Soil from the last Interglacial (*MIS 5e*) corresponds to the pedocomplex **S1**; • The development of the first chernozem pedocomplex (**S2**) within the loessic sequences took place, in southeastern Romania, during *MIS 7*
Timar-Gabor, A., Vandenberghe, D.A.G., Vasiliniuc, S., Panaiotu, C.E., Panaiotu, C.G., Dimofte, D., Cosma, C. (2011)	➢ Optical dating method (*SAR-OSL* technique): ✓ Optically Stimulated Luminescence dating (*OSL*); ✓ single-aliquot regenerative-dose (*SAR*) protocol; ➢ study of grain-size distribution with depth; ➢ comparison of the OSL characteristics and age of fine sand-sized (63–90 μm) quartz to those of silt-sized quartz	Dobrogea: • *Mircea Vodă* (*MV*) *section* (see Fig. 1C; **MV**)	• The *MV* loess -palaeosol sequence: at least, five glacial/ interglacial cycles	• Both sets of ages (obtained by using silt-sized and sand-sized quartz) do confirm that the first well-developed palaeosol (**S1**) is of *last Interglacial* age
Vasiliniuc, Ş., Timar-Gabor, A., Vandenberghe, D.A.G., Panaiotu, C.G. , Begy, R.CS., Cosma, C. (2011)	➢ Quartz-based SAR-OSL dating method: ✓ Optically Stimulated Luminescence (*OSL*) signals from quartz, in combination with the single-aliquot regenerative-dose (*SAR*) protocol; ➢ Comparison between the magnetic age-depth model and the OSL ages	The Romanian Plain: • *Mostiştea* (*Ms*) *profile*; ➢ Comparison between *Mostiştea* (*Ms*; Romanian Plain) and Mircea Vodă (*MV*; Dobrogea) sections (see Fig. 1C; **Ms**, **MV**)	• Four loess -palaeosol units (**L1**, **S1** to **L4**, **S4**) and the Holocene topsoil (**S0**); Investigated**:** **L1** - **S1** - **L2** (25cm below the **L2** top) sequence	• OSL ages obtained for the **L1** - **S1** - **L2** (25cm below the **L2** top) sequence: between 46±7ka - 144±21ka; • The *SAR-OSL* ages confirm the chronostratigraphic position of **S1**: formed during *MIS 5*; this is also in accordance with the *IRSL* chronology established by Bălescu *et al.* (2010) at this locality; • **L1**/**S1** sequence represents the Last Glacial/ Interglacial cycle (in both **Ms** and **MV** sections)
Bălescu, S. (2012)	➢ Optical Stimulated Luminescence (*OSL*) method; ➢ Archaeological information	Dobrogea: • *Mircea Vodă* (*MV*) • *Tuzla/Tz* (Black Sea Shore); (see Fig. 1C; **MV**, **Tz**)	• References to **L1**, **L2**, **L3** loess horizons	• Loess horizons **L1**, **L2**, **L3** formed during the last three Quaternary glacial periods (references to Bălescu *et al*., 2003, 2010): 10ka - 115ka (**L1**); 130ka - 200ka (**L2**); 250ka -300ka (**L3**) ; • Several levels of lithic industries of the Middle and Upper Palaeolithic found within the loess

Author/ Year	Methods used to derive/ confirm the loess/palaeosol chronostratigraphy/age	Location of sections/ profiles	Studied loess - palaeosol sequences	Derived/confirmed age of the loess/palaeosol horizons
Fitzsimmons, K.E., Marković, S.B., Hambach, U. (2012)	➢ correlation of the magnetic susceptibility records (loess - palaeosol profiles from Hungary, Croatia, Serbia, Bulgaria and Romania) with: ✓ marine oxygen isotope stages (*MIS*); ✓ the stacked normalized magnetic susceptibility curves of Lingtai and Zhaojiachuan (Chinese Loess Plateau; Sun *et al*., 2006); ✓ the astronomically tuned oxygen isotope records from *ODP site 677* (Shackleton *et al*., 1990), and the orbitally tuned *SPECMAP* (*SPECtral MApping Project*) oxygen isotope record, respectively (Martinson *et al*., 1987; Opdyke & Channell, 1996)	• A review of the loess of the middle and lower Danube basin; • The loess - palaeosol sequences from Hungary, Croatia, Serbia, Bulgaria and Romania ➢ The Romanian Plain: *Mostiştea/Ms*; ➢ Dobrogea: *Mircea Vodă/MV* (see Fig. 1C; **Ms**, **MV**)	• Maximum five palaeosol horizons (**S1** to **S5**), alternating with loess horizons (concerning the sections from Romania)	• The palaeosol (**S1**) is connected to the last Interglacial (*MIS 5*); • The palaeosol **S2** is associated with *MIS 7*; • **S3**: associated with *MIS 9*; • **S4**: associated with *MIS 11*; • **S5**: associated with *MIS 13-15*; • Both profiles from Romania were correlated with the *Brunhes Chron* [*Matuyama /Brunhes* boundary (781ka): not identified]; • The "young loess" comprises the five uppermost major loess - palaeosol packages, corresponding to ~ **650 ka** (*MIS 16 - 1*)
Buggle, B., Hambach, U., Kehl, M., Zech, M., Gerasimenko, N., Marković, S., Glaser, B., Zöller, L. (2012)	➢ palaeopedological – geochemical multiproxy approach, involving: ✓ grain size analyses; ✓ micromorphological observations; ✓ geochemically based weathering indices; ✓ diffuse reflectance spectroscopy for the determination of the iron oxide assemblage; ✓ rock magnetic parameters ; ✓ n-alkanes as biomarkers for the tree *vs*. grass abundance; ➢ correlation of characteristic fingerprints of the magnetic susceptibility to proxy curves for the global ice volume; ➢ supplemented by pedo-, and tephrostratigraphic marker, allowing correlations to previously established chronostratigraphies from profiles in the region, as well as from Chinese stratotype sections	• Key sections in the Lower Danube Basin and the Middle Danube Basin (Carpathian Basin, Pannonian Basin) Dobrogea: • *Mircea Vodă section* (*MV*) (see Fig. 1C; **MV**)	• Six palaeosol horizons/ pedocomplexes (**S1** to **S6**), alternating with loess horizons	• The chronostratigraphic placement of the pedocomplexes (*MV* section): • **S1** = *MIS 5*; • **S2** = *MIS 7*; • **S3** = *MIS 9*; • **S4** = *MIS 11*; • **S5** = *MIS 13-15*; • **S6** = *MIS 17* • The loess - palaeosol sequence comprises the last **700 ka** of climate history, *i.e.* the last 17 *Marine Isotope Stages*

Note. To maintain the historical character of the synopsis, some specific constituents are expressed/labelled as in the original papers, as follows: **a)** The loess horizons are labelled (columns **4** and **5**, in the Table) as in the original papers (see column 1 and References), *e.g.*, **LI**, **L1** - the first loess horizon; **PsI**, **S1** - the first palaeosol horizon (in both cases, starting from the top of the section/profile downwards). *Exception*: Conea (1970), where **W3** is the first loess layer starting from the top; yet, **GS1** is the first "group of soils", starting from the top; **b)** The acronyms for the "oxygen-isotope stages" (column **5**) are labelled as in the original papers (see column 1 and References), *e.g. MIS* (Marine Oxygen Isotope Stage), *OIS* (Oxygen Isotope Stage). As concerns the early publications, the Quaternary glacial stages *Günz*, *Mindel*, *Riss*, *Würm* and corresponding Interglacial periods (*i.e.*, *Günz-Mindel*, *Mindel-Riss*, *Riss-Würm*) are mentioned (column **5**), as the authors have used them in their papers.

Afterwards, the "*optical dating*", namely the *ISRL* and *OSL methods* have been used (*e.g*., Bălescu *et al*., 2003, 2010; Bălescu & Lamothe, 2009; Bălescu, 2012; Timar-Gabor *et al*., 2009, 2011, 2012; Vasiliniuc *et al*., 2011; see the references therein and Table 1). These new techniques offer several advantages over *TL* dating (Roberts, 2008). Certain ages assigned to specific loess and/or palaeosol horizons (particularly, the uppermost three loess horizons **L1**, **L2** and **L3**), investigated in the Middle - Upper Pleistocene sequences from the Romanian Plain and Dobrogea, were derived or confirmed (see Table 1). Bălescu (2012), speaking about the Dobrogea loess dating, by using the Optical Stimulated Luminescence (*OSL*) method, refers to two previously published papers (Bălescu *et al*., 2003, 2010), in which the chronostratigraphic model based on the results achieved for two sections from Dobrogea (*i.e*., Tuzla/**Tz** and Mircea Vodă/**MV**; see Fig. 1) shows that the three recent loess horizons **L1**, **L2** and **L3** were deposited during the last three Quaternary Glacial periods, that is between 10ka - 115ka (**L1**), 130ka - 200ka (**L2**) and 250ka - 300ka (**L3**). Besides, this loess contains several levels of Middle and Upper Palaeolithic lithic industries (see also Table 1).

Even more recently, Timar-Gabor *et al*. (2012) present "an overview of a five-year research in establishing a reliable chronological framework of some of the most important loess-palaeosol sequences in SE Romania". By using polymineral fine grains and different grain-size fractions of quartz, some Optically Stimulated Luminescence (*OSL*) ages have been obtained for a site located in the Romanian Plain (*Mostiştea*; **Ms**, in Fig. 1) and two other in Dobrogea (*Mircea Vodă* and *Costineşti*; **MV** and **Cs**, respectively, in Fig. 1). Based on the "excellent agreement" between the *OSL* and *post-IR IRSL* age results obtained for the Mircea Vodă section and the data for another site placed in SW Romania, where a tephra layer exists, the cited authors consider that "*the potential of luminescence as a dating tool is demonstrated*". On the other hand, on the basis of their experience in the Saxonian Loess Region, Kreutzer *et al*. (2012) focus - in the paper presented at the same scientific meeting (*i.e*., *DEUQUA General Assembly*, September 16-20, 2012, University of Bayreuth, Germany; see the References) as Timar-Gabor *et al*. (2012) did - on "*the potentials and the recent limits of OSL dating on loess profiles up to the Eemian soil*".

3.3 Integrated magnetic susceptibility and magnetostratigraphic methods; On the possibly "observed" Matuyama/Brunhes boundary within the Romanian Plain loess

Some comments on the updated results achieved for the Zimnicea borehole profile (*ZBhP*) are here presented, the loess - palaeosol sequence (Fig. 2a) being first investigated in 1999/2000 (Rădan, 2000, in Enciu *et al*., 2000; GIR scientific report, unpublished data).

The anisotropy of magnetic susceptibility technique, applied for a small set of cubic specimen resulted from the semi-oriented cores (collected by dr. P. Enciu; Rădan, 2000, in Enciu *et al*., 2000) which were intended for palaeomagnetic investigation, has indicated, in general, a depositional/primary magnetic fabric, which is characteristic for undisturbed sediments. Thus, the "*magnetic recording medium*", represented by the loess - palaeosol couplets, was tested and proved (the small profile fragment at least) suitable for (palaeo)magnetic studies.

In the cited report, the conclusion referred to the interception of the *Matuyama/Brunhes boundary* (*MBB*) within the basal loess, at the depth of 29.2m - 29.7m, so that the overlying loess - palaeosol sequence was assigned to the Middle and Upper Pleistocene, and the underlying deposits to the Lower Pleistocene (Rădan, 2000). Some remarks were done in the same unpublished scientific report on the questionable interception of the *Kamikatsura event* [calibrated by Singer & Hoffman (1998) at 0.886±0.003 Ma, and by Coe *et al*. (2004) at 900.3ka±4.7ka], just below the depth level of ca 32m. It must be added that the *Kamikatsura Event* has recently been identified in the Gold Hill loess (Alaska, USA) (Evans *et al*., 2011). Unfortunately, in the Zimnicea borehole case, the sampling works carried out by Enciu (in 1999) have not provided semi-oriented cores (up/down) to our palaeomagnetic laboratory from the depth intervals m29.7 - m31.9, and m36.8 - m38.7, respectively, so that downwards from ca 30m borehole depth the magnetochronological interpretation of the obtained *ChRM* inclinations is difficult to be precisely performed.

The model with the magnetic susceptibility variations with depth recorded along the borehole F3-Zimnicea (up to m39), and with the vertical distribution of the *ChRM* inclinations determined for the m25.1 - m29.7 depth interval is first published within the present paper (Fig. 2a,b), although this is mostly dedicated to a synopsis of the contributions relating to dating the loess from the Romanian Plain and Dobrogea. An updated interpretation is here presented in order to point out - for the first time in the Romanian loess - a possible interception of the *Matuyama / Brunhes boundary* (*MBB*). Another reason is to remark a very interesting correlation with the "*Lingtai section*" from the central *Chinese Loess Plateau* and with the detailed data of Spassov (2002), and of other authors, concerning the characteristics of the *MBB* location in the loess - palaeosol sequences (*i.e*., "observed" and "corrected"/"true" *MBB*). So, with regard to the *Zimnicea borehole profile* (*ZBhP*), below the fifth palaeosol (**S5**) (Fig. 2a), there is an alternance of "thin loess-like and palaeosol layers", which are overlying a succession of a soil with "progressively hue changing", an alluvial soil, a package of alternating clayey silt and silt beds and a horizon of sandy clays (Enciu & Enciu, 1999; unpublished data). The alternating "thin loess-like - palaeosol layers" are reflected by the magnetic susceptibility (**MS**) variations identified by Kappabridge measurements, so that we labelled them **L6**, **L7** and **L8**, separated by **S6** and **S7** (Fig. 2a). Yet, the magnetic susceptibility record associated with this lower part of the profile, just below the **L6** - **S5**, points out small-amplitude **MS** maxima in the last two palaeosol horizons (**S6** and **S7**) as compared with the overlying palaeosol layers (see, for example, the previous **S5**, but also **S1**, **S2**, **S3**; Fig. 2a). It is very interesting to compare this situation with the case of the Lingtai and Jingchuan sections (consisting of 33 loess - palaeosol couplets; Yang & Ding, 2010). In Fig. 2c, two fragments of these sections are given (the Lingtai **MS** record is also reproduced in Fig. 2d, after Spassov, 2002), where - in the basal part - two very thin palaeosol layers, *i.e*. **S6** and **S7**, can be seen. Their magnetic susceptibility signatures are very similar to those detected in the Zimnicea borehole profile/ZBhP (Fig. 2a), characterised by small-amplitude susceptibilities compared with those expressed by the previous soil layers (**S1** to **S5**). Moreover, it is also worth to remark the smaller amplitude of the maximum pick in the magnetic susceptibility record concerning the palaeosol **S4**, compared with **S1** to **S3** and **S5**, in both the Lingtai section (Fig. 2c,d) and the ZBhP (Fig. 2a). At the same time, the Matuyama/Brunhes boundary (*MBB*) is located at Lingtai and Jingchuan at the level of the same loess horizon, *i.e.* **L8,** as in the Zimnicea borehole profile (Fig. 2). Spassov (2002), speaking about the ″reached major goal – to explain the different MBB stratigraphic positions in the marine oxygen isotope records and the continental susceptibility records of the loess/palaeosol section of Lingtai –″, states that ″the downward shift of the MBB in the loess/palaeosol sequence of Lingtai has been explained by delayed NRM acquisition″. Consequently, he concludes ″the corrected MBB position is now in the lower part of S7 and is dated at 778 ka (Tauxe *et al.,* 1996)″, and ″the time difference between observed and corrected MBB is about 22 kyr″. If we are taking into account the similarity between the magnetic susceptibility and palaeomagnetic signatures of the Zimnicea borehole profile and those of the Lingtai section, and we accept the conclusions of Spassov (2002), then we can consider – as a preliminary assessment – that in our case, the ″*observed MBB*″ is in **L8** (the solid green line, in Fig. 2a) and the ″*corrected MBB*″ is in the lower part of the overlying palaeosol, *i.e.* **S7** (the dashed green line, in Fig. 2a); this corresponds to the *marine oxygen isotope stage 19*, confirming what is stated by Shackleton *et al*. (1990), Heller *et al*. (1987, cited by Spassov, 2002), Zhou and Shackleton (1999, cited by Spassov *et al*., 2003), Heslop *et al*. (2000), and others (see Fig. 2a,d). Actually, this is adoptable, as Spassov (2002) – who studied in detail the directional variations around the *MBB* in the loess/palaeosol section at Lingtai (Central Chinese Loess Plateau) – considers that ″the MBB record is delayed and downwards shifted in the Chinese loess/palaeosol column by 1.5 to 2m corresponding to about 25,000 years″.

With regard to the delayed *MBB* (Fig. 2), we must add that although ″the disagreement between marine and loess records is extensively reported, the exact reason has been disputed″ (Yang *et al*., 2007).

Another interesting observation concerning the ZBhP magnetic signature is the problem of the small-amplitude susceptibilities from the lower part of the Zimnicea profile, which were assigned to two thin palaeosol layers, *i.e.* **S6** and **S7**, which were correlated with the Chinese **S6** and **S7** at Lingtai and Jingchuan sections (Fig. 2). Buggle *et al*. (2009; see also Table 1), who are carrying out a study on the stratigraphy and spatial and temporal palaeoclimatic trends in southeastern/eastern European loess - palaeosol sequences, taking into consideration, among others, two sections from Romania (″Mostiştea″, in the Romanian Plain, and ″Mircea Vodă″, in Dobrogea, respectively; see **Ms** and **MV** in Fig. 1C), refer – in a separate section of the paper – to the ″division of pedocomplexes **S6** and **S7**″. The previous cited authors particularly refer to the ″Koriten″ section from northeastern Bulgaria, and give ″two reasons to doubt that the Koriten **S6**, in terms of Jordanova & Petersen (1999), corresponds to the Chinese **S6**″. The arguments expressed by Buggle *et al*. (2009) are ″the similar susceptibility patterns″ and ″the fact that the acquisition of remanent magnetisation in loess is diagenetically delayed, the B/M boundary being often found in the underlying L8 loess or even in the upper part of S8″. This is exactly what we have above commented, comparing the Zimnicea profile with the Lingtai section, taking into consideration the data of Spassov (2002) with regard to the Chinese loess. Finally, Buggle *et al*. (2009) state ″the correlation of the upper part of Koriten S6 with the Chinese S6 (MIS 17), the middle part of Koriten S6 with MIS 18 (interstadial soil development) and the lower part of Koriten S6 with Chinese S7 (MIS 19)″. So, the cited authors add that ″the *B/M boundary* in Koriten probably indicates the base of the equivalent to the Chinese **S7**″. This example supports our interpretation, where we have pointed out the equivalence of the Zimnicea **S6** and **S7** with the Lingtai and Jingchuan **S6** and **S7**, respectively. Actually, the lowermost parts of the magnetic susceptibility signatures of ″Koriten section″ (northeastern Bulgaria) and ″Zimnicea profile″ (southern Romania) – two sections closely located (see **Zm** and **Kr** in Fig. 1C) – are quite similar and the interpretation of Buggle *et al*. (2009) could be accepted for the Zimnicea profile, as well. The problem of labelling the loess and palaeosol layers is more complicated in the Zimnicea borehole profile case, as the alternating loess-like and palaeosol layers underlying the palaeosol **S5** are thin (according to the description of Enciu & Enciu, 1999). Finally, we add another section inserted by Buggle *et al*. (2009) in their comprehensive analysis, namely the ″Stari Slankamen section″ (Serbia), where the mentioned authors cite Marković *et al*. (2004), who ″as result of the preliminary paleomagnetic investigations, revealed evidence for the Brunhes-Matuyama boundary (MBB) location in the L8″. On the other hand, Jin & Liu (2011), based on ″pedostratigraphic and climatostratigraphic division″, have the opinion that ″the MB transitional zone is not singly recorded in the loess unit **L8** or the paleosol unit **S8**, but in the stratigraphic transition zone which transgresses from **S8** into **L8**″, and they think ″this is important for constructing a new chronology framework for the Chinese loess - paleosol sequences″.

Relating to Zimnicea **L8**, the underlying maximum in the ZBhP magnetic susceptibility record (Fig. 2a) could be **S8**, but further investigation of the "progressively hue changing soil" (description according to Enciu & Enciu, 1999) is needed.

In conclusion, the loess - palaeosol sequence recovered from the Zimnicea F3-borehole (the profile ending with **L8**), which has been investigated by magnetic susceptibility and magnetostratigraphic methods, with correlations to sections from the Chinese Loess Plateau, calibrated to the *Marine Oxygen Isotope Stages* (*MIS*) of the *benthic* $\delta^{18}O$ *record* at the site ODP 677, spans a time interval of **800ka** at least (up to the basal loess **L8**, at the depth of ca 30m; Fig. 2a). This is much more feasible, as very recently, Buggle *et al*. (2012), based on a palaeopedological – geochemical multiproxy approach in a regional context (Middle and Lower Danube Basin), have indicated the chronostratigraphic placement of the pedocomplexes as follows: **S1** = *MIS 5*, **S2** = *MIS 7*, **S3** = *MIS 9*, **S4** = *MIS 11*, **S5** = *MIS 13-15*, **S6** = *MIS 17*. Among the key sections of the Lower Danube Basin, the cited authors have chosen the "Mircea Vodă" profile (with maximum 6 identified palaeosol horizons). Buggle *et al*. (2012) point out that the studied loess - palaeosol sequences in the area comprise at least the last 700 ka of climate history (see also Table 1). In the *Zimnicea Borehole Profile*, we have discussed about a sequence formed by 8 loess horizons and at least 7 interbedded palaeosol horizons (**S8**?), comprising the last 20 *Marine Oxygen Isotope Stages*, at least.

4. SUMMARY AND CONCLUSIONS

The table which encloses the main contributions of the Romanian and foreign scientists related to the age of the loess and palaeosol deposits occurring in the Romanian Plain and Dobrogea (Table 1) is in fact a comprehensive synopsis of the dating methods that have been used over the last half-century and of their results, as well.

The extended table, which triggered the present paper shows the evolution of the dating methods during 1961 - 2012 period. Nevertheless, information on the beginning of the loess studies in Romania, *i.e*. 120 years ago, is presented as an "early history" chapter, before making the comments on the table.

On the other hand, an updated interpretation of the results obtained in 2000 for a loess - palaeosol sequence traversed by a borehole in the southernmost part of the Romanian Plain is for the first time worked up and it is published within this paper. These new data are presented as additional information supporting the integrated magnetic susceptibility stratigraphy and magnetostratigraphic techniques, which hold an important place among the methods that were used to date the Romanian loess.

The anisotropy of magnetic susceptibility investigated for a small collection of semi-oriented cores dedicated to investigating their magnetic polarity has indicated, in general, a depositional/primary magnetic fabric, which is characteristic for undisturbed sediments. Consequently, the "*magnetic recording medium*", represented by the sampled loess - palaeosol couplets, was proved to be suitable for (palaeo)magnetic studies.

A possibly "*observed Matuyama / Brunhes boundary (MBB)*" is considered to be found within the loess **L8**, and because of the "lock-in depth mechanism" taking place in sedimentary rocks, "resulting in an offset between the records and the true positions of magnetic reversals" (*e.g*., Horng *et al*., 2002), the "*corrected MBB*" is supposed to be located within the palaeosol **S7**, corresponding to the *marine oxygen isotope stage 19*. This confirms what is postulated in the literature with regard to the correspondence of the Chinese palaeosol **S7** to the *MIS 19*, and with the delayed Matuyama - Brunhes boundary ("corrected/true *MBB*"), respectively (see citations in Ch. 3.3). Comparisons with the results published for the Chinese loess are very stimulating and they are shortly commented in the paper. However, there is another opinion, *e.g*. of Jin & Liu (2011), who state that the Chinese **S8** should correlate to *MIS19*, and not to *MIS21* [see also Yang *et al*. (2010), citing Wang *et al.* (2006) and Liu *et al.* (2006), "who proposed that the palaeosol **S8**, rather than the palaeosol **S7**, should be correlated with the interglacial *MIS 19*"]. Moreover, Yang *et al*. (2010), referring to the "lock-in depth" concept in the Chinese loess, cite Zhu *et al.* (1998), who suggested that "a palaeoclimatic recording phase lag between the ocean and the continent causes the *M-B boundary* discrepancy". Consequently, a series of important aspects regarding some details of the loess dating by magnetic methods and the correlation with the marine record (oxygen isotope stages) are still disputed.

As Hambach *et al.* (2008) stated for the Chinese loess, the magnetic susceptibility variations in the loess-palaeosol couplets in the sections of the Romanian Plain and Dobrogea "resemble the pattern of the global ice volume record with higher values in palaeosols (interglacials) and lower values in loess (glacials)". Magnetic susceptibility is a reliable proxy for palaeoclimate variations in the studied sections, with higher magnetic susceptibility values recorded in the palaeosol horizons, reflecting warm climate conditions, and lower magnetic susceptibilities in the overlying and the underlying loess horizons, indicating cold periods. Thouveny (1991) speaks about a positive correlation between the magnetic susceptibility and the temperature.

In the Romanian sections, as in all the profiles in the world, each major palaeosol horizon can be correlated with an odd numbered oxygen isotope stage representing a warm and humid interglacial period, while each major loess horizon is correlated with an even numbered *MIS*, representing a cool and dry glacial period. Thus, the magnetic susceptibility signatures recovered from the Pleistocene loess - palaeosol sequences in the two southern Romania areas can serve as a relative dating tool by using the benthic oxygen isotope record from ODP Site 677 (Shackleton *et al*., 1990). Some examples were presented in the previous chapters and more results are inserted in Table 1.

In certain synthesis/review papers, written by foreign and Romanian authors, some loess - palaeosol sections from Romania were integrated within a series of complex patterns to be correlated with profiles from Bulgaria, Serbia, Croatia and Hungary. All these have also been compared with reference profiles from the Chinese Loess Plateau (CLP). Magnetic susceptibility records and magnetostratigraphic data were used in this respect and the correlation with the astronomically tuned benthic oxygen isotope record from ODP site 677 (Shackleton *et al*.,1990) and with the stacked normalized magnetic susceptibility curves recorded for CLP sections (*e.g*., at Lingtai) was carried out. Recently, Marković *et al*. (2012) remark that ″the loess-paleosol sequences in the middle and lower reaches of the Danube River Basin contain some of the longest and most complete continental climate records in Europe covering approximately the last million years“. Yet, the previously cited authors point out that local loess-palaeosol stratigraphic schemes have been defined separately in the large number of countries covered by Danubian loess, resulting in some difficulties in correlating such schemes, and consequently, in limiting the number of basin-wide studies. Anyway, in this context, Marković *et al*. (2012) define a Danube basin-wide loess stratigraphic model and they compare this with the record preserved in the Chinese Loess Plateau and also with the oxygen isotope record in deep-sea sediments; it is a stratigraphic approach which – as it is considered by the authors – ″*can for the first time provide an appropriate base for the development of an integrated European loess stratigraphic scheme*“.

The methods that were applied during the time are well pointed out by means of Table 1 presented in the paper, which covers the last half-century, so that the evolution of the techniques applied for loess dating is implicitly observed: classic stratigraphy/pedostratigraphy, geological – climate stratigraphy (″glaciation“, ″stade/stadial“, ″interstade/interstadial“, ″interglaciation/interglacial“; http://www.inqua-saccom.org/stratigraphic-guide/), isotope stratigraphy/climatostratigraphy, magnetostratigraphy, magnetic susceptibility stratigraphy, palaeopedological – geochemical multiproxy approach, luminescence/optical dating.

Comparisons with magnetic susceptibility and palaeomagnetic signatures recovered by different authors from loess - palaeosol sequences in China or Bulgaria were also used to complete the interpretation of the results achieved for the Romanian sections.

Additional information regarding some special results obtained for the Romanian loess - palaeosol sequences by applying the magnetic susceptibility stratigraphy and magnetostratigraphy, on the one hand, and the luminescence dating (particularly, the thermoluminescence/*TL* method), on the other hand, was presented in two sub-chapters.

Table 1, which represents the main goal of the paper, actually its starting point (see the ″Introduction“), includes the location of the sections under attention for loess dating, and also the constitution of the loess - palaeosol sequences studied in each sampling locality. The profiles particularly investigated in four localities in the Romanian Plain and eight in Dobrogea were characterised by a different number of loess-palaeosol couplets. The biggest number of alternations was found at Zimnicea (Romanian Plain - southernmost point), within a borehole profile (**L1** to **L8**, and **S1** to **S7**, possibly **S8**?) (Rădan, references therein), and at Tuzla section (Dobrogea/close to the Black Sea shore), *i.e.* 7 doublets (**L1** to **L7**, and **S1** to **S7**) (Bălescu *et al*., 2003). Based on 31 studied loess - palaeosol profiles in Dobrogea, Conea (1970) remarks the ″formations of the soil group 7 are better preserved along the Danube River in both number and thickness“. With regard to the Zimnicea borehole profile, the magnetic susceptibility stratigraphy combined with the isotope stratigraphy (marine oxygen isotope record from ODP site 677), and the magnetostratigraphy were the methods applied, while in the other above-mentioned case, the optical dating, by *IRSL* technique, and the correlation to the *Marine Isotope Stages* were used. There were also investigated loess deposits only; for example, this is the case of the Drănic section (western Romanian Plain; **Dn**, Fig. 1C) and of three profiles in Dobrogea, one at Cernavodă (**Cv**, Fig. 1C), and two in the Razelm - Sinoie Lagoonal Complex area (*i.e*., Popina Isle - northern Razelm Lake, and on the northern border of the Golovița Lake - at Jurilovca, respectively; **PIs**, **Jv**, Fig. 1C). Jipa (*in press*), speaking about the ″main facies features“ of the Lower Danube loess deposits, remarks the existence of ″important loess sections located close to the Danube River which show no paleosol intercalations“.

Finally, the results achieved by different authors – over the last half-century – for the loess dating in the Romanian Plain and Dobrogea complete the Table. The last column summarises the determined or suggested ages for the loess and/or palaeosol horizons of the studied sections. If the loess from the Cernavodă section is considered to be accumulated during the upper part of the last glaciation/Würm (Ghenea, *in* Rădan *et al*., 1984), probably around 65 ka (taking into account some references therein, related to **L1**), it seems the loess **L8** from the Zimnicea borehole profile is deposited around 800ka ago.

The different methods applied to date the loess - palaeosol sequences from southern Romania led to results comparable with the data published for other areas of the world, particularly relating to the Chinese Loess Plateau. Its sections are impressive, having been identified 33 soil/loess couplets in complete sequences, *e.g*. at Lingtai and Jingchuan (Yang & Ding, 2010); some data for two fragments of these were used in the present paper.

In conclusion, anyway, not forgeting the existent dispute on the reason of a disagreement between marine and loess records with regard to the *MBB* location (the ″lock-in depth“ magnetisation mechanism), we consider as a tentative interpretation, based on the data enclosed in the comprehensive Table 1, too, that the **L1** to **L8** are correlated to *MIS 4* to *MIS 20* (succession of even numbered ″*oxygen isotope stages*“/*OIS*), and **S1** to **S7** are calibrated to *MIS 5* to *MIS 19* (odd numbered *OIS*), spaning a time period of ca 800 ka. Consequently, according to the Zimnicea borehole profile labelling (the most complete sequence investigated in Romania), the loess - palaeosol couplets **L1**/**S1** to **L7**/**S7** (possibly, the middle - upper part of **S7**) are of Middle Pleistocene - Upper Pleistocene age, while the **L8** (and possibly, the lower part of **S7**), are of Lower Pleistocene age. The arguments are based on the fact that the delayed Matuyama / Brunhes boundary (*MBB*) – because of the so-called ″lock-in depth mechanism“ – is downwards shifted in the "loess - palaeosol column", so that while the "observed MBB" was found within the loess **L8**, the ″corrected/true MBB“ should be placed within the lower part of palaeosol **S7** (the *MBB* is dated – according to ATNTS2004 / ATNTS2012 – at 781 ka). In this context, it is worth to mention Conea (1970), who – based on the ″classic stratigraphy“ studies - assigns the group of soils **GS7**, identified in several sections from Dobrogea, to the ″*Günz-Mindel Interglacial and to older phases of the Lower Pleistocene*“ (see Table 1). The sedimentation rates calculated for each major lithologic unit and an age model will be an objective of the future approach and the results will be presented in a separate paper.

The synopsis, particularly systematised within the comprehensive table which represents the focus of the paper, remarks the interest – over the last half-century – of many Romanian authors to dating the loess and/or palaeosol horizons from the Romanian Plain and Dobrogea, but also the presence of several foreign researchers who carried out syntheses on the loess age problems that have existed in the Middle and Lower Danube Basin.

EPILOGUE

At this moment, we wish to come back to the hot rhetorical question of Hambach *et al*. (2012) (see Prologue), put even in the title of their paper on the stratigraphic comparison between the Chinese Loess Plateau and the Middle Danube Basin Loess (*MDB*): ″**Asia in Europe** ?“.

The numerous papers which support the present synopsis, particularly those published in the last years, do approach the correlation between the European loess sequences and the Chinese loess records, especially by using the magnetic susceptibility stratigraphy, magnetostratigraphy and the astronomically tuned benthic oxygen isotope $\delta^{18}O$ record from the ODP site 677. Most of the compared sections are located, on one hand, in the Middle and Lower Danube Basin (*LDB*) – particularly in the *LDB*, the focus of the present synthesis being the loess of the Romanian Plain and Dobrogea –, and on the other hand, in the Chinese Loess Plateau.

It has been a case when on the basis of the similarity between the magnetic susceptibility records achieved for a loess - palaeosol section from Bulgaria and for the Chinese profiles it has been proposed (Buggle *et al*., 2009) the division of a pedocomplex into three parts, and the upper and the lower parts of the Bulgarian palaeosol were correlated with two Chinese soil horizons. It is about the example of the ″Koriten **S6**“ (Jordanova & Petersen, 1999) and its division into **S6** (upper part) and **S7** (lower part), equivalent to the Chinese **S6** (*MIS 17*) and **S7** (*MIS19*); the middle part of ″Koriten **S6**“ is correlated with *MIS18* (″interstadial soil development“; Buggle *et al*., 2009). This proposal was supported also by the common magnetostratigraphic solution for the location of the Matuyama - Brunhes Boundary (*MBB*): the *MBB* in ″Koriten“ section probably indicates the base of the equivalent to the Chinese **S7**.

Another case analysed by Buggle *et al*. (2009) is of the ″Mircea Vodă“ section (Dobrogea, Romania). They state that ″the lowermost susceptibility peak of the Mircea Vodă **S6** does not seem to represent the Chinese **S7**“ and ″rather, the **S6** of Mircea Vodă is an equivalent of the Chinese **S6**“. Referring to the same ″Mircea Vodă“ section in a very recent paper, Buggle *et al*. (2012) count the major Interglacial pedocomplexes according to the Chinese nomenclature, and reach to the chronostratigraphic placement of the pedocomplexes (Chapter 3.3). The results show that the studied loess - palaeosol sequences in the area comprise the last 700 ka of climate history, *i.e*. the last 17 *Marine Isotope Stages*.

Finally, we stop to a third case, selected from the present synopsis as well, *viz*. the updated interpretation of the ″Zimnicea Borehole Profile“ (*ZBhP*; Romanian Plain). The comparison of the magnetic susceptibility (**MS**) signature recorded for the loess - palaeosol sequence traversed by a geological borehole (F3-Zimnicea) with the **MS** variations with depth for the ″Lingtai“ and ″Jingchuan“ sections in the Chinese Loess Plateau, and also with the marine oxygen isotope $\delta^{18}O$ at the ODP site 677 was used to number the ″ZBhP“ Interglacial palaeosol horizons (**S1** to **S7**, possibly **S8**?), and the Glacial loess horizons (**L1** to **L8**), respectively. It is worth also to emphasise the similarity concerning the ″small amplitude“ susceptibilities which characterise the palaeosols **S6** and **S7** compared with the **MS** maxima expressed by the previous soil layers (**S1** to **S5**), both in the Zimnicea profile and in the two Chinese sections. Lastly, we add the similar solution for the *Matuyama - Brunhes Boundary* (*MBB*) location in the Romanian and Chinese profiles: the ″*observed*“ *MBB* - within **L8** (*MIS 20*), and the ″*corrected*“/″*true*“ *MBB* - within the lower part of **S7** (*MIS 19*), respectively.

These three cases which we have selected from the synopsis represent, at the same time, three composite arguments for a possible answer to the question of Hambach *et al*. (2012) which has given the start of the *Epilogue*. The multi-proxy signatures recovered from the European and Chinese loess - palaeosol archives account for a change of the question mark into an exclamation point, in the context of the subject approached in the present paper: **Asia in Europe !** Actually, the cited authors mention that ″in Eurasia a unique mid-latitudinal loess-belt ranging from China to South-Eastern Europe provides insights into climate evolution since the Pliocene, at least". And at the western edge of the Eurasian loess belt, in the Lower and Middle Danube Basin, there are ″loess plateaus providing almost continuous archives of Pleistocene palaeoclimate", which ″were presumably formed under similar environmental conditions like in the Chinese Loess Plateau and in other Central Asian loess areas" (Hambach *et al*., 2012).

Therefore, at the end of the incursion through the last half-century made along the synthesis dedicated to the loess dating, we can back up Pécsi's statement (Pécsi, 1990) selected as *motto* of the paper: ″*Loess is not just the accumulation of dust*", but we could also confirm its slightly modified version due to Buggle *et al*. (2012), *i.e*. ″*Loess is not just accumulated dust*". Therefore, the loess - palaeosol sequences are relevant for geosciences, they are Quaternary archives for palaeoenvironmental reconstruction and are considered (Hambach *et al*., 2012) as ″some of the most detailed and long-term terrestrial records of Pleistocene climate change".

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