AGE AND PEDOGENIC RECONSTRUCTION OF A PALEO–RELICT CHERNOZEM SOIL FROM CENTRAL TRANSYLVANIAN BASIN

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Abstract: The "chernozem" area of Transylvanian Lowland has been of much debate in the last two centuries. The paper presents pedological and geochronological evidence that the chernozem soils of the Central Transylvania have relict Late Glacial–Early Holocene features and at least partially must be clasiffied as paleo–relict in the sense of Reuter (2000).

Key words: radiocarbon dating, pedogenic carbonates, paleo–relict features, Central Transylvania

During the last century a much debated issue for Romanian pedological and botanical scientific communities was the age and origin of the Central Transylvanian Mollisol cover in conjunction with the associated forest–steppe vegetation.

In this study we have found at least partial evidence that the chernozem soil cover in Central Transylvanian was a stable feature long before the ascent of human activities and that, in the Late Holocene, they have suffered a degradation process to the present state of Haplic and Luvic chernozem. The process is somewhat similar with that inferred for Central and Southern Germany, where chernozems formed in the dry steppe or forest–steppe conditions were degraded to brown earths, the resulting polygenetic cover being named Braunerde (Parabraunerde)–Tschernozem (Catt 1989).

Because the nature and properties of different soil horizons can hold information with respect to the time pedogenic factor an investigation was undertaken to determine if the typical chernozem features were indeed Late Holocene (Post–Neolithic) as it has been accepted before.

Methods. The soil profile was described and sampled following the procedures of Birkeland et al. (1991). The age analysis on the mollic epipedon was out of the question for obvious reasons (easy infection with very new organic material). Therefore, the radiocarbon age was calculated for the pedogenic carbonates nodules of an undisturbed Haplic chernozem. The dated material was sampled from the core of the nodules in order to obtain an age as close as possible to the time of the initiation of secondary carbonate accumulation. Radiocarbon age found is 14700–14320 cal. yrs (reference for datasets used: Stuiver et al. 1998). Humus content analysis was conducted using Wolkley–Blake Method modified by Gogoasa (1971). Colour of the humic epipedon in humid state is 10 YR 2/2. Calcium carbonate content was determined by the Chittick method. A more detailed analysis on the evolution of the carbonate precipitation process is currently under work (thin sections micro–morphology of the carbonate nodules).

Discussion and Interpretation of results

The soil profile is situated on gentle (5 %) north–facing cuesta reverse slope and according to the present FAO (World Reference Base for Soil Resources, 1998) classification can be included in the Haplic chernozem type with clear polygenetic features (Am–Bvkw–rCkw). As we can see the stagno–gley features affect both Bv and Ck horizons, which is incongruent with the normal position that we would expect for a calcic horizon, and that is above the stagno–gley. The pedogenic carbonate nodules are covered by a thin film of illuvial clay and are, at present, destroyed by the hydromorphic processes. The calcic horizon begins at a depth of 30 cm, another characteristic that is not specific to the present day climate and pedogenetical processes. The morphology of the soil profile shows no obvious signs of mechanical disturbances (sheet erosion, solifluction etc) so the profile is not truncated as far as we can tell.

Given the facts presented above several conclusions can be drown:

1. The soil profile shows features that are not congruent with the present day pedogenesis features (e.g. calcic horizons in superficial position, gley features above the calcic horizon, huge secondary carbonate nodules (3–5 cm diameter) specific to the arid pedogenesis).

2. Overlying of antagonist features (gley over calcic horizon, clay illuviation over pedogenic carbonate nodules) proves the polygenetic nature of the soil. Given its past and current features the profile can be classified as paleo–relict chernozem in the sense of REUTER (2000) and its at least partially similar in morphology with Braunerde–Tschernozem soils of Germany as seen by Rau (1965, 1969) cited by Catt (1989).

3. The nature of the calcic horizon (huge secondary carbonate nodules) and the absolute age of the first inner carbonate layer of the nodules gives information on the period of the initiation of this arid type of pedogenesis. The calcic horizon has begun its formation in the climatically clement but dry period of deglaciation following the peak stadial of Late Glacial period. The vegetation record of this period (Pop 1932) indicates that steppe biocenoses have dominated a large part of the Transylvanian

Basin. If the matter of climate, vegetation and soil history of Late Glacial–Early Holocene is quite clear, the question remains open for the Middle and Late Holocene periods. Pollen records that indicates the invasion of forest in Transylvanian Lowland cannot exclude the preservation of forest–steppe islands, as we think is the case in Central Transylvania. Moreover, as Catt (1989) pointed out, some scientists failed to find palynological evidence for some well known climatic changes of the Holocene period.

4. The preservation of semi–conservative features as the Ck paleohorizon of the soil, with huge carbonate nodules simply indicates that this process could not have taken place under humid forest conditions, where these structures are dissolved and iluviated at much greater depth.

5. It is a matter of common sense to consider that for the “chernozemisation” process, deforestation is not sufficient. We can see this in the areas of Central Europe and even in the regions of Transylvania outside forest–steppe area where large forested areas were clear–cut a long time ago. The humid climate of these regions (which is proper for a nemoral natural vegetation) simply did not allow the chernozem genesis. It is necessary a sub–arid temperate continental climate to start this process of “chernozem aggradation”. The deforestation of a small surface like Central Transylvanian Forest–Steppe area is not able to turn the local climate into a forest — steppic one! Why do we not have chernozems and phaeozems in other, long time deforested areas, of Transylvania and Central Europe?

Final remarks. The vast majority of the researches have stressed that prior to the Bronze Age increase of human activities the entire Transylvanian Basin has been uniformly forested (Borza 1928, Ielenicz 2000). Following the supposedly large–scale deforestation and the subsequent invasion of grass vegetation, the luvisols soil–cover has suffered a process of agraddation that had as principal result the formation of a mollic epipedon (Jakab 1972, Jakab et al. 1968). Some scientists regard the Central Transylvanian black soils as not being true chernozems for they have hydromorphic processes along their profile (especially of a stagnic nature). They consider these soils as being gley–stagnic phaeozems. Even if this theory may be accepted these soils are not of a forest type but they are typical for the “meadow steppe” vegetal associations (Ianos 1999) — “wiesen steppe” in German (Walter 1968), “pratosteppa” in Latin. When comparing the phaeozems profiles from Russian meadow steppes provided by Walter (1968) with those from Transylvania (Mavrocordat & Nicolau 1964, Preda & Crisan 1958) it can be easily concluded that they belong to the same type of soil developed under almost similar climatic and vegetation parameters. The chernozems–phaeozems soil types occur in Central Transylvania mainly on the northern slopes (Mihai et al. 1955, Florea aet al. 1971) so the south–facing slopes dry conditions cannot be invoked as a pedological factor for the formation of these soils. A comparison between the forest–covered Northern Transylvanian Lowland and the southern forest–steppe enclave under discussion shows that in the same geological, morphological and human settings we have two very different soil and vegetation covers. So, these factors cannot be considered either, as cause of differentiation. Consequently, we consider that for many reasons deforestation cannot be hold responsible for the "chernozem aggradation" and that the presence of these particular soil type it is a clima–varians feature that has been more or less influenced by human activities.

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