Complex Pedogenesis in the Eopleistocene Paleopedocomplex of the Northern Ciscaucasia: Polygenetic Models

ИНСТИТУТ ГЕОГРАФИИ РАН

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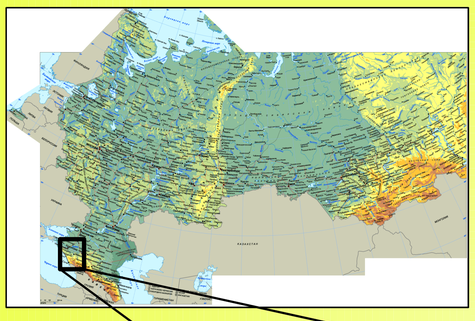
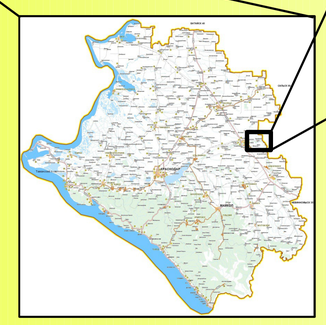
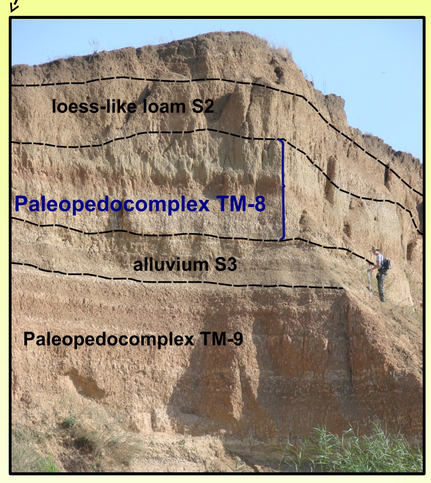
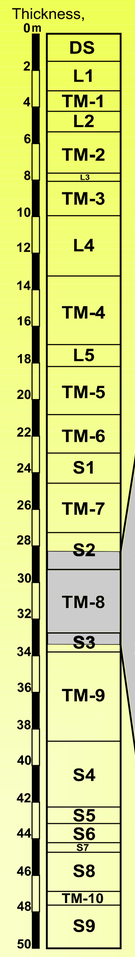
Object:
geographical location





The object of research is the composite paleopedocomplex TM-8 investigated in the Temizhbeksky section which is located in the natural outcrop of the Kuban river (South-West Russia, Northern Ciscaucasia) and has a thickness of about 50 m. The outcrop includes ten spaces which have definite pedogenetic features: four as individual soils (TM-1, TM-3, TM-6, TM-10) and six as paleopedocomplexes (TM-2, TM-4, TM-5, TM-7, TM-8, TM-9).





Stratigraphy of the geological outcrop, paleopedocomplexes lithology, soil horizons and profiles

Paleopedocomplex TM-8 has a thickness of about 3,5 meters. It consists of eight lithological layers (clayey, loamy, silty-loamy) which have fluvial (litho-layers 1 and 2) and complex eolian-deluvial (litho-layers 3, 4, 5, 6, 7 and 8) genesis. There are six horizons of four individual soil profiles developed in this sediments. There are none «clear» sediment separates individual soil profiles: paleosoils are inerserted in each other (pedogenic features that relate with younger pedogenesis are detected in elder soil profiles).

Main scientific challenges:

1. There has been a significant change in the genetic paradigm in pedology in last 20-30 years: instead of the prevailing concept of monogenetic soil's development (one climate - one landscape - one soil) there is intensive development of soil polygenetic model. Most of soils have experienced repeated changes of landscape-climatic environments in their development and recorded information about them and their evolution.

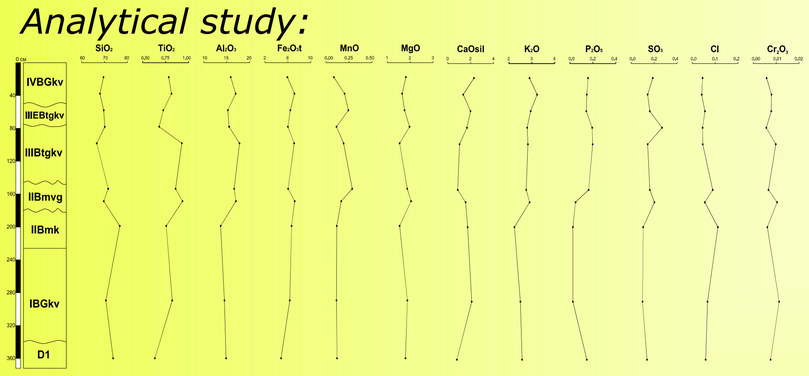
2. How to divide features are formed by mono-, poly-, inflicted pedogenesis and diagenesis?

3. Researching of composite pedocomlexes is a new possibility for the Eopleisocene investigation — the least studied interval of the Quaternary period.

Goal of the study:

Identification of combination and time sequence of soil forming processes and landscape-geographical environments by mono- and polygenetic models in the composite Eopleistocene paleopedocomplex

Analytical study:



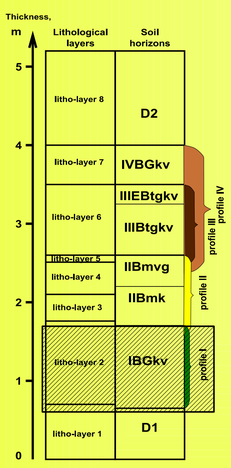
The data of chemical analysis as an integral parameter demonstrates both the lithological and pedogenetic differentiations because of complex composition of soil horizons and litho-layers. So it is only auxiliary method which verify genetic hypothesis. Thus the main method is morphological research.

Morphological study:

The lower profile lying in two litho-layers and formed by the single calcic horizon with gleyic and vertic features. Pedogenesis could be explained by polygenetic model. The second profile transfixing four different litho-layers by cambic and calic horizons. Paleosoil also has weak vertic and stagnic features which could be explained by the soil self-development or "weak" soil evolution in a low-amplitude climate fluctuations. The third profile lying in two litho-layers and formed by two horizons of stagnic luvisol which also has vertic and calcic features referred to the younger upper paleosoil. The upper profile lying in four litho-layers and consist's of one horizon which has vertic, stagnic and calcic features. Temporal and spatial relations of these features could be explained by three evolution stage of pedogenesis.

Results:

Profile 1



Set and time sequence of soil forming processes:
1. Carbonates migration and stagnic gleization;
2. Slitization and stagnic gleization;
3. Carbonates migration (releted with pedogenesis-2.

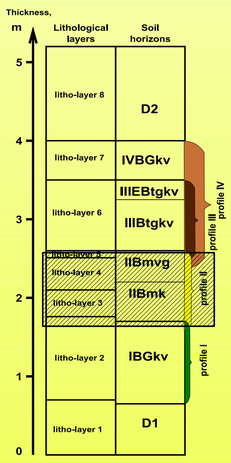
Tipe of pedogenesis:
- polypedogenesis;
- inflicted pedogenesis.

Duration of pedogenesis:
- n*10³ years

Climate change:
- warm semi-arid (semi-humid?)
- warm semi-humid (with more contrast humidification).

Geomorphological position, sedimentation mode:
- floodplane → terrace
- possible synsedimentary pedogenesis

Profile 2



Set and time sequence of soil forming processes:
1. Rubefication, block-prismatic structure formation, carbonates migration;
2. Weak slitization;
3. Strong stagnic gleization (related with pedogenesis-4.

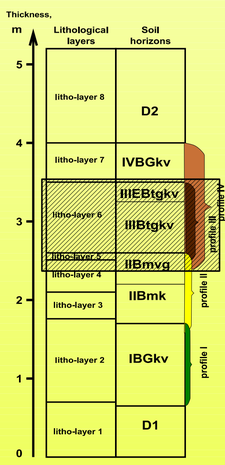
Tipe of pedogenesis:
- monopedogenesis or «weak» polypedogenesis;
- inflicted pedogenesis.

Duration of pedogenesis:
- n*10³ years

Climate change:
- warm semi-arid - semi-humid

Geomorphological position, sedimentation mode:
- terrace;
- weak slope processes.

Profile 3



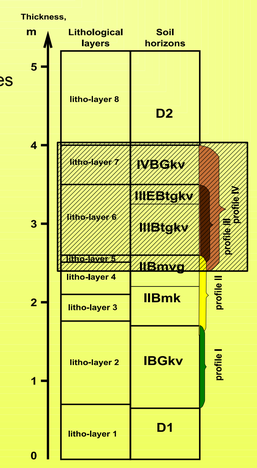
Set and time sequence of soil forming processes:
1. Lessivage, partluvation, stagnic gleization;
2. Strong stagnic gleization, slitization, carbonates migration (related with pedogenesis-4.

Tipe of pedogenesis:
- monopedogenesis;
- inflicted pedogenesis.

Duration of pedogenesis:
- n*10² — n*10³ years

Climate change:
- warm-temperate humid

Geomorphological position, sedimentation mode:
- terrace;
- weak slope processes.



Set and time sequence of soil forming processes:
1. Carbonates migration;
2. Slitization and stagnic gleization;
3. Strong stagnic gleization.

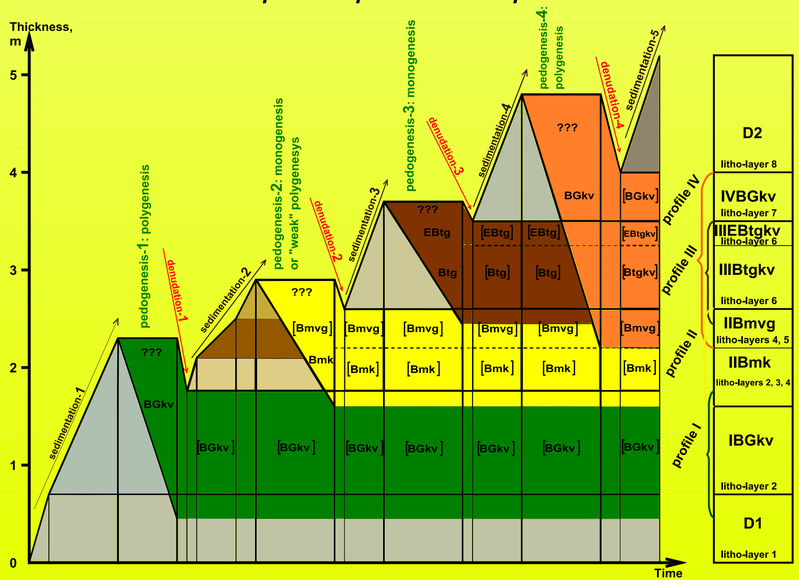
Tipe of pedogenesis:
- polypedogenesis;

Duration of pedogenesis:
- n*10³ years

Climate change:
- warm semi-arid;
- warm semi-arid — semi-humid;
- warm-temperate — cold humid.

Geomorphological position, sedimentation mode:
- terrace;
- weak slope processes.

The model of paleopedocomplex formation:



Conclusions:

1. Paleopedocomplex contains the following options for pedogenesis:
   - monopedogenesis;
   - "weak" polypedogenesis;
   - polypedogenesis;
   - inflicted pedogenesis.

2. Paleopedocomplex had been formed for n*10³ — n*10⁴ years.

3. Paleopedocomplex documented the development of the valley of the Kuban river in the Eopleistocene: deepening the river channel (floodplain and terrace stages).

4. Paleopedocomplex documented the climate change in the Eopleistocene:
   - warm semi-arid;
   - warm semi-humid;
   - warm semi-arid – semi-humid;
   - warm-temperate humid;
   - warm semi-arid;
   - warm semi-humid;
   - warm-temperate or cold humid.

5. The term "polygenesis" has three different meanings in this case. The first – the pedocomplex polygenesis which is in a complex sequence of lithological layers and soil horizons. The second is in evolution of the individual paleosoil profiles in the pedocomplex which reflect a climate change. And the third is in inheritance of buried soil horizon by later pedogenesis.