Soil formation features of Andoma geological section

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Abstract. Andoma geological section is a unique natural monument. A feature of this territory is colors diversity of parent rocks, granulometric composition and agrochemical characteristics. The soil landscape of Andoma section is not well developed due to strong erosion processes. Soil formation is at the initial stages in some areas so that Andoma geological section is an excellent scope. The study of this research will allow a better understanding of the differences in the soil formation process on different mother rocks.

1. Introduction
Soil formation is a long, time-stretched, complex natural process of friable rock converting into soil. The primary soil formation process coincides with weathering process at initial stages of pedogenesis. Soil formation and weathering subsequently are separated in space and time. The process of soil development and its evolution and transformation begins.

In the process of soil formation, each soil involves a number of stages, direction, duration and intensity of which are determined by a specific set of soil factors and their evolution at each point of the Earth’s surface. The process includes stages of initial soil formation, soil development, climax state and stage of soil formation process activation.

Natural soil factors are currently less affecting the soil than man-induced factors. However, there are naturally-occurring factors that are not soil-forming but influence soil.

This may be the activity of surface water.

In the process of the geological cycle, surface fluid waters – rivers, seas, lakes – are geological agents, that is, they participate in the transformation processes of the Earth's crust in particular rocks. Landscapes, sedimentary cover, and then soil are historically formed under the influence of geological agents. At the present time, coast abrasion is one influences on soil from lakes and rivers.

Edaphic conditions are one of forest stand factors which the composition and condition of phytocenosis depends on. There is a basis of soil – rock – in addition to soil formation factors such as climate, relief, flora and fauna, time [1, 2]. Soil texture and plant nutrient content depends on ground type.

1.1. Object of study
The study object has been Andoma geological profile (figure 1, 2) which belongs to the Andoma hilly moraine elevated middle-taiga landscape [3] and is located on the shore of Lake Onega in Vytegorsky district of Vologda region. The section name is derived from the Andoma River. The hydronym apparently arose from the Vepsa phrase “andmaa” – “giving land” [4].
Limestone, dolomites and sandstones of coal age have been noted as parent rocks on the landscape area. At the Quaternary time, Andoma Hill was located on the ice divide between two ice tongues of the Last Glacial Period. Further uplifts contributed to the erosive division of the hill, and the accumulative activity of the glacier gave the hill a modern form. Hilly and upland relief revails in the landscape area with altitudes up to 260 meters. Karst relief forms are common in places of close to bedding of carbonate rocks.

Figure 1. General view of the investigated object.

Andoma geological cross-section – Mountain Andoma – is the south-western edge of the Great Andoma Hill, a section of Devonian sediments. It originated, like many soil-forming rocks of the taiga zone, as a result of glacier movement and is a glacial dislocation – a disturbance of rock formation caused by glacier movement. The absolute height of the profile is about 85 meters.
Andoma Hill is composed of multi-colored, red, green, purple sandstones and sands which clay and marl are subject to. Clays are encountered in blue and gray shades (figure 3, 4). Fossils of the Devonian period are quite frequent. The deposits age is about 350-420 million years.

Mountain Andoma is a geological monument of nature, a specially protected natural area with federal status. Therefore, it is important to carry out studies of soils and bedding rocks to explore the history of the soil formation process, especially in conditions of constant abrasion by Lake Onega.
few metres of subsoil goes under water as a result of abrasive processes, a slope of the territory and high rainfall.

2. Methods and Materials
The work program provided for the study of land-cover in different areas of the territory. Cuts of soil were laid and different subsurface rocks on which soil was formed were selected for this purpose. The higher layer and root range were also selected. At the first stage, the size distribution and properties of various stones were studied in the laboratory.

The researches were conducted according to generally accepted methodology. Soil texture was determined according to Sabanin method [5], soil carbonate content – by acidimetric – base on their destruction by a hydrochloric acid solution with subsequent titration of its residue with a sodium hydroxide solution. Humus content was determined by Tyurin method, hydrolytic acidity and exchangeable base status – by Kappen method, reaction parameters of the soil solution – by potentiometric analysis. Nitrates were determined by phenol disulphonic acid method [6].

3. Results and Discussion
A major factor affecting soil formation is parent material. It is the parent rock that largely determines the morphological features, water and thermal conditions, and soil fertility. Soil texture has the greatest influence on soil fertility. It is soil texture that determines aggregate state of future soil and features of organic material accumulation [7].

The results of particle size distribution of composing clay stones are shown in table 1.

| Number of sample | Size frequencies, % | Soil name by particle size distribution |
|------------------|---------------------|----------------------------------------|
|                  | Physical sand       |                                        |
|                  | Large and medium 1 – 0.25 mm. |                                       |
|                  | Small 0.25 – 0.05 mm. |                                         |
|                  | Coarse dust 0.05 – 0.01 mm. |                                         |
|                  | Clay fraction, mm.   |                                        |
| 1 (light coloured)| 14.69                | Sand clay                              |
|                  | 72.44                |                                        |
|                  | 2.7                  |                                        |
|                  | 10.25                |                                        |
| 2 (red)          | 5.2                  | Medium-textured loam                   |
|                  | 47.5                 |                                        |
|                  | 8.86                 |                                        |
|                  | 38.77                |                                        |

The differences in granulometric composition of different soil-forming rocks were revealed during the analysis of the data in table 1. Part of them has a relatively light composition and this is sand clay which represented by light areas of rock, and red-colored rocks entitled a medium-textured loam have a heavier composition. These findings suggest differences in nutrients in the soil formed on these rocks.

Soil fertility is known to be closely related to the particle size composition of the parent rock, namely the clay fraction content. Clay particles absorb better, prevent washing and accumulate organic matter and plant mineral elements (Nitrogen, Phosphorus, Kalium) [8]. Therefore, studies were carried out on some indicators of soil fertility in the next stage. The results are shown in table 2.
ceed and clay. The content of carbonates in the rock demonstrates the presence of calcium and

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n-9 abrasion and erosion processes.

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In conclusion, the rock as a soil formation factor is determined by both the granulometric and

humus substances in soils which is indicator in clay rocks and in the soil under vegetation layer. It’s perhaps related to the presence of

medium magnesium. Light sand clay is likely to be made of bottom materials of

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calcareousness in soil clay (light coloured) during the study for the presence of carbonates in rocks.

alkalization in sand rocks and under field layer. It suggests a neutral environment in different rocks acidic reaction.

succession phase [9] in which the study objects are at the early stage – when the humus accumulates mainly through phytomass of herbaceous vegetation. In the last stages of ecological succession, carbon accumulation is mainly due to living ground vegetation typical for forests, needle litter and wood coarse debris. These stages are characterized by formation and accumulation of forest floor with

In terms of exchange acidity, all studied samples are close to neutral with minor deviations towards alkalization in sand rocks and under field layer. It suggests a neutral environment in different rocks and soils, as evidenced by base saturation. The all samples are saturated. Such results were expected after study for the presence of carbonates in rocks.

Active boiling of coarse dust (0.05 – 0.01 mm) under the influence of HCl was revealed in sand clay (light coloured) during the study of particle size distribution. A quantitative analysis on calcareousness in soil-forming rocks was subsequently conducted. It’s been established that sand clay rock (light coloured) has a carbonate content of 31%. Medium-textured loam (red coloured) contents 11% carbonates. The content of carbonates in the rock demonstrates the presence of calcium and magnesium. Light sand clay is likely to be made of bottom materials of the ancient sea in part, and medium-textured loam is of glacial (Quaternary) or older origin [10].

Nitrogen availability of rocks and soils is very low. However, there is a tendency to increase this indicator in clay rocks and in the soil under vegetation layer. It’s perhaps related to the presence of humus substances in soils which the content and accumulation of nitrogen and other mineral elements depend on [11, 12].

4. Conclusion

In conclusion, the rock as a soil formation factor is determined by both the granulometric and chemical composition of soils. The study has been shown that the presence of carbonates, regardless of their amount in different rocks, contributes to an increase of rocks saturation and then soils with bases. It has an impact on element mobility in the soil and their accessibility to plants and, as a result, increased soil fertility.

In this way, the rocks of Andoma Hill may potentially contribute to soil formation that high-productive trees can be formed on. At present, the existing glint and trees are being destroyed by abrasion and erosion processes.

Table 2. Soil fertility performance of root range and some stones.

| Sample (colour, texture) | Content, % | PH | Content, mg Eq/100 g |
|-------------------------|------------|----|---------------------|
|                         | Humus      | V  | H2O | KCL | Hydrolytacidity | Ca+Mg | NO3 |
| 1(light, sand clay)     | 0.3        | 92 | 8.3 | 6.8 | 0.32           | 8.36  | 0.43 |
| 2(red, medium loam)    | 0.4        | 95 | 8.1 | 6.7 | 0.39           | 7.7   | 0.71 |
| 10(light, sand)         | 0.5        | 98 | 8.2 | 7.0 | 0.26           | 15.2  | 0.70 |
| 9(red, clay)           | 0.8        | 90 | 8.5 | 6.7 | 0.19           | 1.76  | 1.6  |
| Root area (under wood vegetation) | 0.2 | 96 | 8.4 | 6.6 | 0.39           | 10.12 | 0.78 |
| Root area (field layer) | 5.8        | 98 | 8.3 | 6.9 | 0.51           | 22.37 | 1.27 |

Analyzing the indicators of table 2, the following conclusions can be drawn that the content of humus – despite the tendency to increase in rocks with heavier granulometric composition – varies slightly in different species reaching the level of extremely poor soils. A humus horizon taken under the grass cover stands out from the glint height. The humus index reaches 5.8% here that allows us to classify soils as richer. It follows that the organic matter in the soil annually that allows humification processes to proceed more intensively. The content of organic carbon (humus) in soils is influenced by the succession phase [9] in which the study objects are at the early stage – when the humus accumulates mainly through phytomass of herbaceous vegetation. In the last stages of ecological succession, carbon accumulation is mainly due to living ground vegetation typical for forests, needle litter and wood coarse debris. These stages are characterized by formation and accumulation of forest floor with acidic reaction.
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