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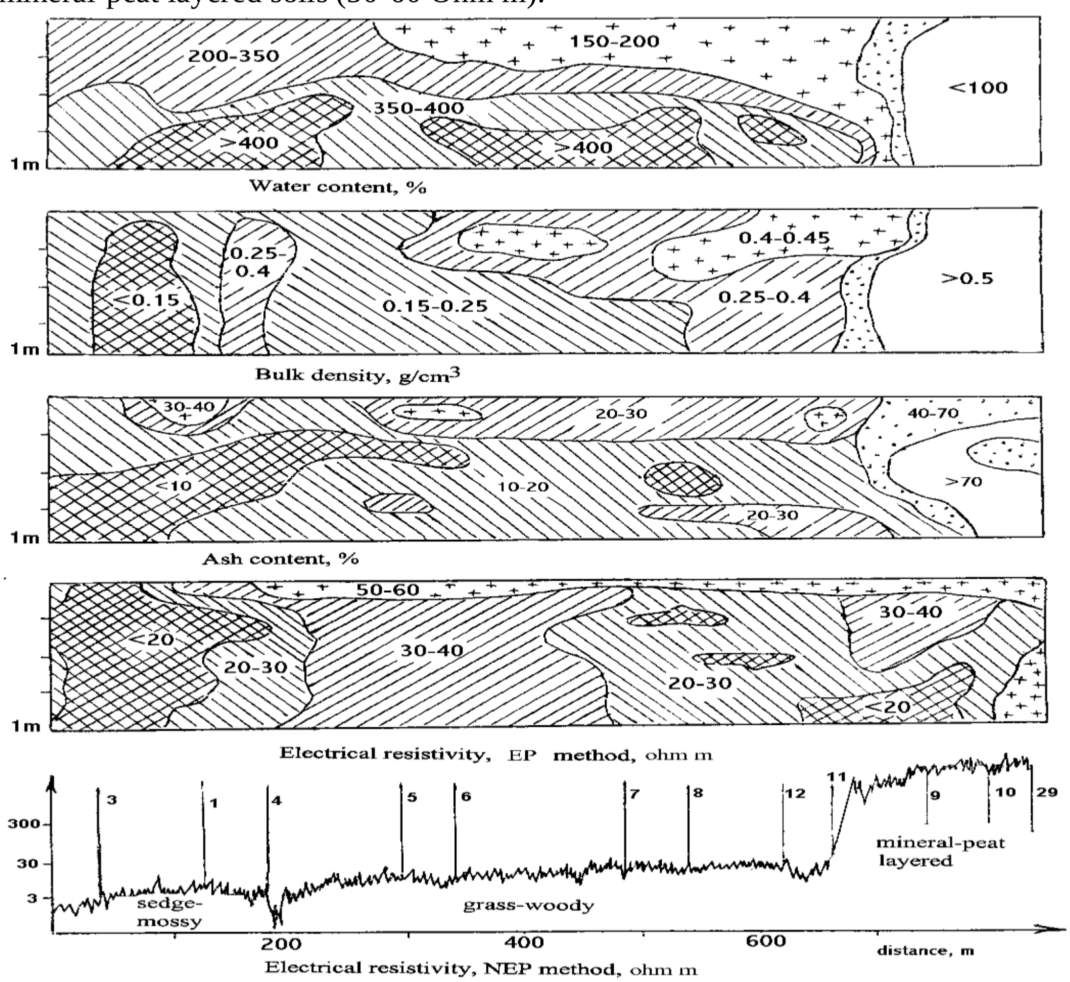
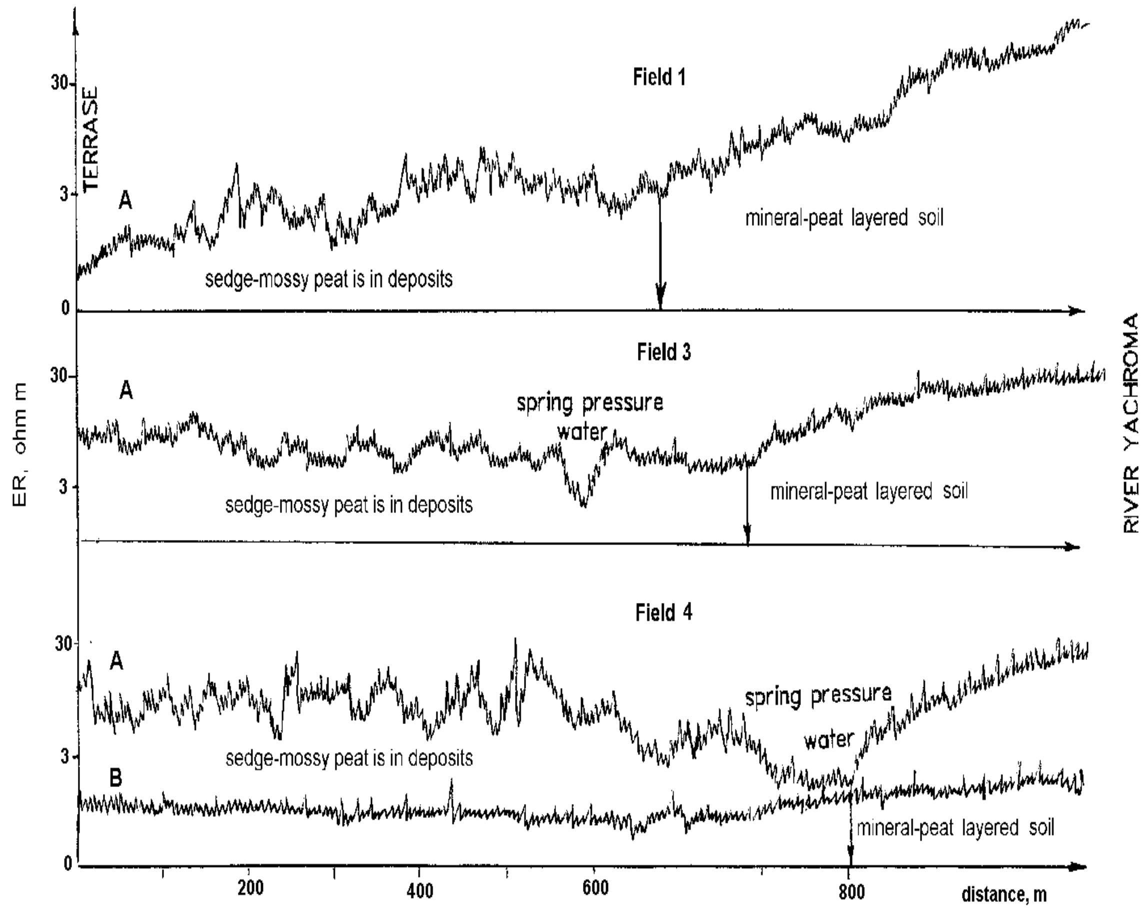
Mapping alluvial soils of humid areas with electrical geophysical methods

Valley soils of humid areas are comprised of various peat and sandy soils of alluvial or lacustrine origins. These soils are located in subordinated positions in a landscape and accumulated high amounts of organic matter and mineral nutrients. Fluctuation of the river bed in space often causes highly complex soil cover in a valley. Studying those soils with conventional methods of soil mapping is very time and resource consuming. Therefore, we tested the electrical geophysical methods of non-contact electrical profiling (NEP) and electrical profiling (EP, LandMapper® ERM-01) for mapping peat and mineral alluvial soils formed in the glacial valley of Yachroma river.

The distinction in botanical structure of peat and hydrology conditions at the different zones of the valley causes distinction in physical and chemical properties of sedge-mossy, grass-woody, and mineral-peat layered soils (Figure). The sedge-mossy peat typically has lower ash content and bulk density, and higher water content, than the grass-woody peat. Electrical resistivity of sedge-mossy peat soil is minimal (<20 Ohm m) in comparison with resistivity of grass-woody (30-40 Ohm m) and mineral-peat layered soils (50-60 Ohm m).



The non-contact electrical profiling method was used for quick mapping of these soils. The area with mineral-peat layered soils is outlined by the highest resistivity (up to 300 Ohm m on NEP profile). Resistivity is sharply reduced on peat soils (3 Ohm m). Method of NEP provided similar results for the other fields of CPBRS (Fig. 2). From fields 1 to 5 the area of mineral-peat layered and grass-woody soil gradually decreased, whereas the area of sedge-mossy peat soil increased. On the NEP profiles the areas with different genetic types of deposits were characterized by different resistivities. The areas with the resistivity about 3 ohm m characterized presence of sedge-mossy peat in the deposits (Fig. 2). At the transition from mineral-peat layered soils through grass-woody to sedge-mossy peat, the resistivity reduced from 300 to 3 Ohm m. The areas with seeping water were possible to detect on NEP profiles as places with the minimum resistivity (Fig. 2). Such extremely low resistivity in spring areas was, probably, because of enrichment of these places with mineral substances (iron and calcium) brought by groundwater.



By results of NEP survey we constructed plan of the CPBRS experimental fields, which reflected the basic areas with different peat deposits. The plan agreed with the previous maps of the area developed with conventional geological survey. Based on the distribution of different peat and mineral deposits, an optimal plan of agricultural usage was proposed. Mineral-peat layered soils were recommended to use under intense vegetable production. The rest of the area in fields 1, 2, and 3, especially where seeping groundwater is close to the soil surface, could be used for grass pasture. The whole territory of field 4 and 5 could be used either for pasture or crop rotations of vegetables and grasses. Although such management scheme would reduce usage of soils for high cost vegetable crop, it decreased the cost required for reclamation of these soils and service of drainage systems.