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SOIL CARTOGRAPHY IN THE USSR

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Soil cartography is a branch of soil science and a branch of thematic cartography as well. The origination of soil cartography in Russia is associated with the names of the outstanding scientists-naturalists K.S.Veselovsky and V.I.Chaslavsky who compiled the first general maps of European Russia in I85I and I879,respectively. However,soil cartography as an independent branch of science took shape somewhat later following the creation of genetic soil science and establishment of the main laws of soil geography by V.V.Dokuchaev (I880-I898).

During those and subsequent years the work on soil evaluation resulted in compiling a great number of soil maps of gubernias[x], uezds[x] and individual farms. An active part in this work was taken by V.V.Dokuchaev and his deciples (N.M.Sibirtsev,A.R.Ferkhmin,K.D.Glinka,L.I.Prasolov,S.S.Neustruyev and others).

The maps compiled in the course of those investigations differed from all the previously compiled soil maps by the presentation of genetic soil groups,soil particle-size distribution and soil-forming rocks.This period in the development of soil cartography was crowned in I900 with the compilation of a New General Soil Map of European Russia at a scale of I : 2,520,000 showing, for the first time ,soil zones and in some of them (chernozemic) subzones as well as soil-forming rocks and particle-size distribution of soils. Soils of moun-

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x) Words denoting provinces and districts in pre-revolutionary Russia.

tain regions were especially distinguished.

A great contribution to the development of soil cartography was made by the expeditions (working under the guidance of K.D.Glinka) organized in I908-I9I4 by the Department for the Migration of Population which collected wealth of materials on the vast, previously unstudied (with respect to soils)regions of Siberia, the Far East, Kazakhstan and Central Asia. The work of these expeditions resulted in I920's in compiling (at a scale of I: 4,200,000) the Soil Map of the Asiatic USSR by K.D.Glinka, L.I.Prasolov, S.S.Neustruyev and N.I.Prokhorov; the Soil Map of Turkestan and Southern Kazakhstan by L.I.Prasolov; the Soil Map of the Cotton-Growing Regions of Central Asia by S.S.Neustruyev,and a number of other maps.

Compilation of these maps was a serious contribution to the development of the methods of soil cartography. Apart from the dominating soils shown before, these maps represented the accompanying ones which made it possible to give an idea of the character of soil mantle. At that time, the first Soil Map of the World was published by K.D.Glinka.

Early in I930's when small-farm agricultural production was being transformed into large agricultural enterprises a new stage in the development of large-scale soil cartography began with the mapping of vast territories and compilation of medium-scale maps. An enlargement of map scales resulted in the creation and utilization of a more detailed classification of soils which stipulated greater informational capacity of soil maps.

This period was characterized also by an intensive development of small-scale and general cartography by L.I.Prasolov and his deciples and co-workers (I.P.Gerasimov, N.N.Rozov, E.V.Lobova, N.N.Lebedev and others) at the Dokuchaev Soil Institute,which led to the compilation of new soil maps of the world, continents, the USSR and European Russia

published separately and in the Big Soviet Atlas of the World, and to the publication of a number of maps of the Union republics, "krais" x) and "oblasts" x). Work was also started on the preparation and compilation of a multi-sheet Soil Map of the Soviet Union.

The cartographic techniques of the soil mantle presentation were significantly perfected in the course of compiling the above-mentioned maps. The creation of a single colour scale using a wide range of colours (for showing soil types) and their hues as well as colour hatchings (for showing smaller taxonomic units) was rather significant. Alongside with the creation of this colour scale, a system of letter-figure indices was elaborated which makes the reading of maps significantly easier. Finally, black hatchings and symbols were proposed for showing soil-forming rocks and particle-size distribution of soils.

The presentation of various complicated forms of the soil mantle was being improved. The typification of the most complicated and contrast forms of the soil mantle - soil complexes was made for a number of arid regions(E.V.Lobova) and some regions of the tundra zone (E.N.Ivanova). Special colour grids for soil maps were created. A system of colour symbols was elaborated for showing heterogeneous but less complicated forms of the soil mantle.

The employment of such a great number of cartographic techniques has noticeably changed the appearance of soil maps and significantly increased their informational capacity while preserving their clearness which allowed to approach not only to the presentation of the dominating soils, but also of the structure of the soil mantle by depicting its composition and, in a number of cases, giving an idea about the quantitative relationship of its compo-

x) Large administrative territories.

nents. All this has raised soil cartography to an essentially new level and has consolidated its position among the independent branches of soil science.

During the last decade, in connection with the development of the notion on the structural build-up of the soil mantle as a general phenomenon and elaboration of the classification of the soil mantle structures (V.M.Fridland), there appeared new methods of soil cartography which allowed to significantly increase the informational capacity of maps. The small-scale and even general maps compiled by employing these methods contain a considerable part of information which can usually be found on large-scale maps. They contain also practically all the information which is presented on land type and land system maps whose compilation was started in 1960's in Australia with a view to characterizing land resources.

This type of map can be exemplified by the Soil Map of the Arctic compiled at a scale of ;:10,000,000 for the Atlas of the Arctic which shows not only the composition of the soil mantle, i.e. its components, but also its micro- and meso-structure (E,N.Ivanova et al., 1973). The Soil Map of the Mongolian People's Republic compiled at a scale of 1: 2,500,000 (N.A.Nogina et al., 1974) may serve as another example of the general soil map. In this map the structure of the soil mantle is presented by a different (than in the above-mentioned maps) method which gives ground to think that the principle of compiling soil maps with the representation of the soil mantle structure can be realized in a different way.

The Soil Map of the USSR at a scale of 1: 2,500,000 whose program was elaborated at the Dokuchaev Soil Institute in 1972 is being compiled on principally the same basis as the Map of the Arctic. The authors'elaborations of this map have already been completed and there are their originals for all 16 sheets of the Map. Now the editorial work and preparation of colour mock-ups (separate parts of the Map) are under way.

At present, soil maps are being compiled presenting the soil mantle structure at larger scales.

The evolution of the soil map contents, associated with increasing their informational capacity, has stipulated the development of the principles of generalization which is imperative for compiling maps of different scales: from large-scale to general ones. Only detailed maps presenting the elementary soil areals (depending on the complexity of the soil mantle their scales usually vary from 1: 200 to 1:2,000) are compiled without generalization.

At the first stages of the soil cartography development when maps presented only the dominating soils the following two types of generalization were employed:

(1) the classificational generalization, i.e. the transition from the presentation of lower classificational units to the higher ones (for instance, the soddy -,weakly -, medium- and strongly - podzolic soils were united into soddy-podzolic);

(2) the contour generalization impling the unification of the contours with identical soils and the exclusion of small contours which are not distinguished on the map compiled at a smaller scale.

Later on, generalization began to incorporate the methods of preserving on a map those soils whose contours disappear with a decrease in the scale (symbols, etc.). Now generalization includes also the typification of the soil mantle structure which makes it possible to preserve on a map the information about the complexity and contrast of the soil mantle and geometrical forms of spatial successions. The considered general principles of generalization have not yet been incorporated in detailed instructions on its application for compiling soil maps, therefore, the methods of generalization (its fundamentals and applicability to various form of the soil mantle) need further development.

When compiling soil maps, generalization, as a rule,

implies the elucidation and preservation on the generalized map the typical peculiarities of the soil mantle and the character of distribution of its component soils. The first task (realized in legend generalization) implies the establishment of soils which are most significant and representative for characterizing the territory being presented and selection of the mapping categories. The second task involves the choice of soils most significant for presenting the peculiar features of the soil mantle and its structure. The third task involves generalization of the boundaries between soils that ensures (at any scales of mapping) the preservation of the natural pattern pertinent to soils of different types. These tasks are solved in the course of a comprehensive study of the territory being mapped, i.e. while establishing the regional peculiarities of the soil mantle, the laws of distribution of its component soils and the dependence of soil boundaries on various natural factors. To accomplish generalization one should know its cartographic principles: scale resolution, limits of legibility of hatched and colour presentations, methods of generalization, etc.

The contemporary period in the development of soil cartography is characterized by the elaboration of methods and principles of soil map compilation which take into consideration the soil mantle structure and its most complete presentation in the maps. Further solution of methodical problems of generalization demands an analysis of the levels of organization of the soil mantle in the studied territory; elucidation of geographical regularities pertinent to every level of organization which, as a rule differ from the regularities governing other levels of organization.

This work must be followed by the selection of the most significant regularities which should be reflected on a map and, finally, by the elaboration of artistic means allowing to make the contents of a map most intel-

ligible.

Depending on the object and scale of cartographic presentation all soil maps compiled in the Soviet Union fall into five groups: (a) soil maps of the world, continents, the USSR and its separate large regions (the scales of such general maps are usually less than 1: 1,000,000); (b) maps of the Union republics, krais and oblasts (predominantly medium (seldom small) scale varying from 1: 1,000,000 to 1: 200,000; (c) maps of administrative regions (medium and sometimes large scale from 1: 100,000 to 1: 25,000); (d) large-scale maps of individual farms (from 1: 50,000 to 1: 10,000); (e) detailed maps of experimental fields and crop-testing stations (from 1: 5,000 to 1: 500). Naturally, such a wide range of scales of soil maps demands differentiated approaches and elaboration of various methods of their compilation. General, small- and medium-scale soil maps (groups a and b) are compiled on the basis of generalization of the larger scale maps as well as route soil investigations and utilization of various auxiliary geographical materials, viz.topographic, geological, geomorphological, botanical and etc. maps; textural maps and schemes, literary descriptions, etc. Maps of groups c,d,e are compiled on the basis of complete, different scale soil surveys and utilization of topographic maps, aerial photographs and (in some cases) of various thematic maps.

The legends of maps are based on the existing genetic classification of soils. Soil-forming rocks and particle-size distribution of soils are shown in the maps also.

Soil maps of collective and state farms as well as soil maps of districts are compiled by special groups of specialists working in land management and projecting-research institutes of the Ministry of Agriculture. They also compile some soil maps of oblasts. The general maps of the world, continents, the USSR and its large regions as well as the majority of maps of the Union republics, krais and

oblasts are compiled by research institutions and higher educational establishments.

By the present time, large-scale soil maps of collective and state farms have been compiled covering an area of more than 600 mln.ha. An intensive work aimed at compiling district soil maps is under way. Considerable number of soil maps of oblasts and Union republics have been compiled. A number of soil maps of the world, continents, the USSR and its large regions have been published.

Maps of different scales constitute a single system. They are related by a single soil classification principal identity of their contents and a common system of their design. This identity of maps is their significant merit which must be preserved in principle. However, specific possibilities of every scale group of maps in presenting certain levels of organization of the soil mantle and geographical regularities pertinent to these levels as well as different practical utilization of maps necessitates greater specificity of these scale groups. Hence, significant methodical work should be aimed mainly at creating standard legends for the soil maps compiled at different scales.

Numerous regional atlases including small-scale soil maps of many regions of the Soviet Union were published over the last 15-20 years. These maps are in good agreement with other natural maps contained in these atlases. At the same time, the soil maps in different atlases possess their specific features and are not always in strict agreement with each other.

In the USSR, apart from the common soil maps, many special soil maps: soil-reclamative, soil-erosional, soil-agrochemical, etc. are compiled. The contents of these maps can significantly differ from the contents of common soil maps. The soil-reclamative maps characterize not only soils, but also the deeper soil-forming rocks,

depth and degree of salinity of ground waters,etc. The soil-agrochemical maps cotain information on the fertilizer requirement and efficiency of various fertilizers and chemical ameliorants. The soile-rosional maps present different forms and various degrees of soil erosion,the degree of soil stability to erosion processes and contain information on the methods of erosion control. Depending on the purposes of their utilization, these maps are compiled at different scales.

Besides general and special soil maps carrying comprehensive characteristics of the soil mantle, various cartograms are compiled in the USSR which present limited properties of soils: nutrient reserves, reaction, degree of overmoistening degree of stoniness,etc. These cartograms compiled at a large scale by the Special Agrochemical Service of the Ministry of Agriculture of the USSR cover the agricultural territories of collective and state farms.

In spite of a significant specificity of soil cartograms any of them can be properly compiled if only the compilers take into considration the genesis of soils and all their properties. Therefore, all these cartograms are compiled on the basis of soil maps. Both soil and agrochemical maps of collective and state farms are periodically corrected: the former in 10-15 and the latter in 3-5 years.

As has been mentioned above, the legends of soil maps are based on the soil classification which is reflected in the system of artistic means and,primarily,in colour presentation. The choice of colours in the soil cartography for presenting various soils is not incidental. The range of colours for the soil maps proposed by L.I.Prasolov in 1930's is used (with some modifications) at the present time. This range of colours reflects the main principles of soil classification. Every soil type is represented on a map by its own colour. The hues of the main colours addopted for the soil types are used for showing soil subtypes,whereas soil kinds are shown through the saturation of the particular hue. Soil genera are presented by colour hatchings. Automorphic soils are shown by the range of colours from red to yellow. Blue and green colours

are used for presenting hydromorphic soils and violet colours for showing solonetz and solonchak soils. Soils of mountain massifs are shown by the colour dominating in the soil areal and light inclined hatching. Such a method of colour presentation of soils allows to visually unite the congeneric natural landscapes. The heterogeneity of the soil mantle is reflected on a map by a system of colour symbols and by colour shaped grids. The soil particle-size distribution is shown on the maps by a system of soil hatchings, and soil-forming rocks - by black symbols. The decorative design of soil maps becomes more and more complicated with the growth of their informational capacity.

Soil maps of districts, collective and state farms are obligatory supplemented by explanatory notes characterizing the conditions of soil formation and soils and giving recommendations on soil improvement and rational utilization of soil resources. Maps of smaller scales are frequently published together with the monographs dealing with the soils of the region presented on a particular map.

Soil maps are used in the agricultural production, when reclaiming soils, for the solution of problems relating to land management and for many other practical purposes. They are also used in the research work and as illustrative material in higher and secondary educational establishments.