COMPILATION OF SOIL MAP FOR AMUR RIVER BASIN: THE MAIN PARAMETERS

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INTRODUCTION

The accepted conception of creation of GIS-support for ecological condition research in Amur River basin decrees that geo-information space of the geosystem should consist of three main information blocks [1]. These are National Geographical information block, Social Economic information block, and Management information block. Unified digital coverage "Soils" for the basin is an immediate constituent of the first block. It is important to note that this coverage is to fulfill several important functions in the information system. First, it supplies information about the patterns of soil cover distribution in the basin. Second, it is a verified source for compilation of a soil map for the territory of the whole basin. Third, it is a component (along with relief, vegetation, and geology) for compilation of a landscape map of the basin. In turn, the map is natural basis for planning and management of the territory's steady development. The digital coverage "Soils" has been made on Arc/Info, ArcView platforms at the detailed scale of 1:2,500,000 of common projection, according to the main rules [2]. The database (attributive table) includes separate fields with information about dominant soils, associated soils, parent material, and relief.

MATERIALS AND METHODS

The digital coverage "Dominant Soils" for Amur River basin is based on the soil maps of the Russian Soviet Federative Socialist Republic, the Mongolian People's Republic, and the People's Republic of China. The maps were compiled over the years by members of different soil science schools and at different scales: The Soil Map of the Russian Soviet Federative Socialist Republic, Scale 1:2.5 M [3]; The Soil Map of the Mongolian People's Republic, Scale 1:2.5 M. [4]; the digital coverage "Soils of the Northeastern China", compiled in collaboration with soil scientists from China and in accord with soil nomenclature, adopted in China. Additionally, a number of soil maps at smaller scales were used [5, 6, 7, 8]. When compiling the digital coverage "Dominant Soils", the principle of preserving the source map data in the fullest was upheld [9]. For the Russian and Mongolian parts of Amur River basin the source map data on soil mapping polygons was coded and added to the database. As for the digital coverage "Soils of the Northeastern China", its data on soil mapping polygons underwent multistage generalization with regard to the specific character of the region. Then the data was coded and added to the database. When compiling the legend of the digital coverage "Dominant Soils", the compiling the legend of the digital coverage "Dominant Soils", the principle of preserving the source map data on soil mapping polygons was coded and added to the database. As for the digital coverage "Soils of the Northeastern China", its data on soil mapping polygons underwent multistage generalization with regard to the specific character of the region. Then the data was coded and added to the database. When compiling the legend of the digital coverage "Dominant Soils", the compiling the legend of the digital coverage "Dominant Soils", the compiling the legend of the digital coverage "Dominant Soils", the compiling the legend of the digital coverage "Dominant Soils", the compiling the legend of the digital coverage "Dominant Soils", the

national soil classifications and nomenclatures of the source soil maps in Russia, Mongolia, and China.

The legend of the Soil Map of the RSFSR [3] includes soil names of two nomenclatures – the one used when the map was compiled [10] and the previous one [11]. The legend also has a number of newly adopted soil names which were either retained in later soil classifications in Russia [12, 13] or given at least partial correspondences. In order to avoid terminological difficulties we use soil names of the Soil Map of the RSFSR for "English Name" section of the digital coverage legend. The soil names for the Mongolian part of Amur River basin generally coincide with the soil names of the Soil Map of the RSFSR. The legend of the Soil Map of the MPR also has a few outdated soil names that were omitted in later soil classifications [12, 13]. We found it necessary to fully retain the soil nomenclature of the source soil map in order to avoid terminological discrepancy.

The soil names for the Chinese part of Amur River basin are diverse. Many soil names, adopted in China, correspond to Russian ones, and such soil names are preserved in our legend (e. g. Chernozems, Chestnuts, Grey forests, etc.). Some soils of the Chinese soil classification [14] do not correspond to Russian ones, but they have possible correlates among Russian soils. In the legend of the digital coverage "Dominant Soils" for Amur River basin names of such soil are substituted by the ones, adopted for their Russian correlates. The Chinese soil names are given in parenthesis (e. g. Brownzems (Brown earths)). In a few cases the soil names, used in the legend of the source soil map, were unofficial traditional names. Such soil names were correlated to the soil names of the Chinese soil classification [14], and their possible (partial) correlates were found in the Russian soil classification. In the legend of the digital coverage "Dominant Soils" for Amur River basin names of such soil are substituted by the ones, adopted for their correlates soil classification [14], and their possible (partial) correlates were found in the Russian soil classification. In the legend of the digital coverage "Dominant Soils" for Amur River basin names of such soil are substituted by the ones, adopted for their correlates in Russia. The official and the traditional Chinese soil names are given in parenthesis (e. g. Chernozem-likes (Black earth or chetu).

Soils of mountainous regions of Amur River basin that belong to the same soil classification taxon as soils of plains are not listed in "Soils of Mountainous Regions" section of the source map legends and the digital coverage legend. This section includes soils that are not found in piedmonts and plains of Amur River basin.

The "English Name" section of our legend includes soil names, adopted for the Russian soil nomenclature in English [15, 16, 17].

The soil nomenclature of the legend of the digital coverage "Dominant Soils" for Amur River basin is correlated to the soil nomenclature of the Revised legend of the FAO-UNESCO Soil Map of the World [18]. The correlation is based on literary data [19, 20, 21, 22, 23], electronic resource data [24], and "Dominant Soils of the World" CD data [25]. The soil nomenclature of the present legend is also correlated to the soil nomenclature of the World Reference Base for Soil Resources (WRB). The correlation is based on literary data [26] and electronic resource data [24].

RESULTS AND DISCUSSION

The legend of the digital coverage "Dominant Soils" for Amur River basin reflects the soil nomenclatures, adopted in Russia, Mongolia, and China. Beside this, the soil nomenclature of the legend is correlated to the soil nomenclatures of FAO-UNESCO and the World Reference Base for Soil Resources (WRB).

Diverse soils of Amur River basin are grouped in the legend in full accord with landscape and geographical zoning principle, upheld in the source soil maps in Russia [27], Mongolia, and China: soils of tundra, taiga and coniferous-broadleaved forests; soils of broad-leaved forests and wooded steppe; soils of steppe; soils of dry steppe. Hydromorphic, saline, alluvial, anthropogenic, and mountainous soils also make separate groups. Due to the paper length concerns only a part of the legend that includes zonal soil groups is given below (Table).

The complex and specific soil cover of Amur River basin is due to the combination of contrasting natural conditions (climate, relief, vegetation, parent material) within the territory. According to soil and geographical zoning [28] the territory of Amur River basin lies within two soil-bioclimatic belts: the boreal (temperate cold) belt and the subboreal (temperate warm) belt. Diverse soil cover of Amur River basin reflects the specificity of the territory's bioclimatic conditions (Map 1, 2). When describing the fragments, we use soil names from "English name" section of the legend in order to fully preserve their informative value. In our opinion, these names reflect the complex character and diverse nature of the regional soil cover better than the more generalized soil names of FAO-UNESCO and WRB nomenclatures [20]. The target map scale and the character of geographical distribution of soils in Amur River basin allowed us to preserve soil mapping polygons of the source soil maps [3, 4] at taxonomic levels of "soil type", "sybtype", "genus", and "kind". The soil names in "English Name" section reflect this low-level taxonomic division. The nomenclatures of FAO-UNESCO and WRB deal with units of higher taxonomic levels reference soil groups and soil subunits, and these can't fully reflect diversity and specific distribution of soils in the region under study. If necessary, the legend allows easy correlation between the "English Name" section nomenclature and those of FAO-UNESCO and WRB.

The Western part of Amur River basin (Map 1) is a part of Mongol-Manjur mountainand-plain area of Euro-Asian subboreal steppe region [29]. This part of the basin includes bordering areas of Russia, China, and Mongolia. It is characterized by soil cover of highly complex structure and by specific soil formation conditions. Absolute heights of ridges are 1000-1200m, and those of intermontane plains bordering Lake Dalainor are 550-750m. The climate is maximum continental with highly contrasting amplitudes of temperature fluctuations. Scattered areas of grey forest soils are found in the South of Zabaikalie (Russia) within the transitional zone on taiga and steppe border. In China the transitional zone has a continuous area of dark-grey forest soils that covers the Northwestern offshoots of the Great Khingan Ridge. In Mongolia the forest-steppe zone with characteristic areas of grey forest soils is absent due to mountainous relief with mountains and basins alternating within small areas. In the Western part of Amur River basin the steppe zone forms a continuous band that covers the Western offshoots of the Great Khingan Ridge in China, the offshoots of the Borshchovochny, Kukulbeisky, and Argunsky Ridges in Zabaikalie (Russia), and the Eastern offshoots of the Hentei in Mongolia. Chernozems of Eastern Siberian group are dominant in the soil cover of the area. These are washed chernozems, either noncalcareous or meal-calcareous. The profile of these soils is often immature, shallow, and stony. The soils undergo long periods of deep freeze. Light, luvic, and typical chernozems are found in China, meal-calcareous and noncalcareous chernozems are found in the South of Zabaikalie (Russia), and meal-calcareous contactly-meadowish chernozems are found in Mongolia.

The Zeisko-Bureinskay Plain (Map 2) has areas of specific meadow-chernozem-like soils that form a separate soil type called "Amur prairie meadow-chernozem-like soils". They are widely used in agriculture. Their analogues – chernozem-like soils – are found in the Chinese part of Amur River basin. They border areas of meadow soils and form band-like areas on more elevated elements of relief. Their Chinese name is black earths, and their traditional Chinese name is chetu. These soils are widely used in agriculture.

Soil	Soil Name			
code	Name in English Russian Legend	Name in the Revised legend of the Soil Map of the World FAO-UNESCO, 1990	Name in the World Reference Base for Soil Resources, 1998	
				S
1	Podburs light tundra	Gelic Podzols (PZi)	Cryosols Haplic (CRha)	
2	Podburs tundra (without subdivision)	Ferric Podzols (PZf)		
	SOILS OF TAIGA AND SOILS O	F CONIFEROUS AND BROAD-I	LEAVED FORESTS	
3	Gleyzems weak-gley peaty-humic taiga	Gelic Gleysols (GLi)	Cryosols Histic (CRhi)	
4	Gleyzems peaty-muck taiga			
5	Taiga peaty-muck high-humic non-	Gelic Cambisols (CMi)	1	
	gleyic			
6	Podzolics, mostly shallow podzolics	Dystric Podzoluvisols (PDd)	Albeluvisols Haplic (ABha)	
7	Podzolic-gleys peat and peaty	Gleyic Podzoluvisols (PDg)	Albeluvisols Histic (ABhi)	
9	Sod-pale-podzolics and podzolised	Eutric Podzoluvisols (PDe)	Albeluvisols Umbric (ABum)	
	brownzems			
10	Podzolised brownzems (Beijang			
	bleached)			
11	Sod-pale-podzolics and podzolised	Gleyic Podzoluvisols(PDg)	Albeluvisols Gleyic (ABgl)	
	brownzems deep-gleyic and gley			
12	Podzolised brownzems meadow (Beijang			
	bleached meadow)			
13	Podzolised brownzems gley (Beijang			
	bleached gley)			
15	Podzols humic-illuvial	Haplic Podzols (PZh)	Podzols Carbic (PZcb)	
16	Podzols illuvial-humic-ferrugenous		Podzols Haplic (PZha)	
	(without subdivision)			
17	Podzols dry-peaty		Podzols Histic (PZhi)	
18	Podzols gley peaty and peat, mostly	Gleyic Podzols (PZg)	Podzols Gleyic (PZgl)	
	humic-illuvial			
20	Podburs taiga (without subdivision)	Cambic Podzols (PZb)	Podzols Entic (PZet)	
21	Podburs dry-peaty		Podzols Histic (PZhi)	

Legend of the Soil Map of the Amur River Basin (fragment)
Soil Compendium

22	Podburs ochric		Podzols Rustic (PZrs)
23	Brownzems raw-humic illuvial-humic	Dystric Cambisols (CMd)	Cambisols Dystric (CMdy)
24	Brownzems raw-humic		
25	Brownzems raw-humic gley	Gleyic Cambisols (CMg)	Cambisols Gleyic (CMgl)
26	Sod-brownzems acid (Grayed and albic	Dystric Cambisols (CMd)	Umbrisols Haplic (UMha)
	browns coniferous forest)	<u>.</u>	
27	Sod-brownzems weakly-unsaturated and	Eutric Cambisols (CMe)	Cambisols Eutric (CMeu)
	saturated (Browns coniferous forest)		
28	Sod-brownzems gleyic and gley	Gleyic Cambisols (CMg)	Cambisols Gleyic (CMgl)
29	Sod-taiga deep-permafrost (including	Eutric-Gelic Cambisols (CMe-i)	Cambisols Eutric-Gelic
	residual-calcareous)		(CMeu-ge)
30	Sod-calcareouses (including leached and	Rendzic Leptosols (LPk)	Leptosols Rendzic (LPrz)
	podzolised)		
31	Volcanics ash typical	Haplic Andosols (ANh)	Andosols Haplic (ANha)
32	Dark volcanics ash	Umbric Andosols (ANu)	Andosols Umbric (ANum)
33	Volcanics ash on basi c rock	Mollic Andosols (ANm)	Andosols Mollic (ANmo)
	-	AVED FORESTS AND WOODEI	
34	Brownzems acid	Dystric Cambisols (CMd)	Cambisols Dystric (CMdy)
35	Brownzems acid podzolised		
36	Brownzems weakly-unsaturated (Brown	Eutric Cambisols (CMe)	Cambisols Eutric (CMeu)
27	earths)	-	
37	Brownzems weakly-unsaturated		
38	podzolised Brownzems gleyic and gley	Clavia Combigala (CMa)	Combigele Clavie (CMel)
38	Dark brownzems	Gleyic Cambisols (CMg) Eutric Cambisols (CMe)	Cambisols Gleyic (CMgl) Umbrisols Haplic (UMha)
40	Dark brownzems grayed	Dystric Cambisols (CMd)	Onorisons frapric (Olvina)
40	Dark brownzems albic	Dysure Cambisois (Civid)	Umbrisols Albic (UMab)
42	Dark brownzems meadow	Haplic Cambisols (CMh)	Umbrisols Haplic (UMha)
43	Dark brownzems gley	Gleyic Cambisols (CMg)	Umbrisols Gleyic (UMgl)
44	Dark brownzem-likes	Haplic Cambisols (CMh)	Umbrisols Haplic (UMha)
46	Grey forests	Haplic Greyzems (GRh)	Luvisols Albic (LVab)
47	Greys forest non-podzolised		Phaeozems Luvic (PHlv)
48	Dark-grey forests	1	Phaeozems Greyi-Luvic
			(PHgz-lv)
49	Fine forest sands	Cambic Arenosols (ARb)	Arenosols Protic (ARpr)
50	Meadow-forests deeply freezen	Umric-Gelic Leptosols (LPu-i)	Umbrisols Gelic (UMge)
	= -	SOILS OF STEPPE	
51	Chernozems luvic	Luvic Chernozems (CHl)	Chernozems Luvic (CHlv)
52	Light chernozems	Luvic Phaeozems (PHI)	Phaeozems Luvic (PHlv)
53	Chernozems deeply-effervescing and	Haplic Chernozems (CHh)	Chernozems Chernic (CHch)
	noncalcareous on sandstones and sands)		
54	Chernozems noncalcareous (mostly		
	contactly-meadowish		
55	Chernozems typical		
56	Chernozems calcareous	Calcic Chernozems (CHk)	Chernozems Calcic (CHcc)
57	Chernozems meal-calcareous		
58	Chernozems meal-calcareous, including		
	leached, typical, ordinary, southern		
50	(chernozems washed)		
59	Chernozems meal-calcareous contactly-	Haplic Chernozems (CHh)	Chernozems Haplic (CHha)
()	meadowish	-	
60	Chernozems meal-calcareous shallow Chernozems solonetzic	Luvie Chernozome (CUI)	Charnozama Luvia (CIIIv)
61 62	Chernozems solonetzic Chernozems solonehakous	Luvic Chernozems (CHI)	Chernozems Luvic (CHlv)
02	Chemozenis solonchakous	Luvic Chernozems (CHh)	

64	Meadow-chernozemics (Chernozems meadow)	Haplic Phaeozems (PHh)	Phaeozems Gleyic (PHgl)
65	Meadow-chernozemics deeply freezen	Gelic Phaeozems (PHi)	
66	Meadow-chernozem-likes "Amur prairie"	Gleyic Phaeozems (PHg)	
67	Chernozem-likes (Blacks, Chetu)	Haplic Phaeozems (PHh)	Phaeozems Haplic (PHha)
68	Chernozem-likes (Blacks meadow)	Gleyic Phaeozems (PHg)	Phaeozems Gleyic (PHgl)
69	Chernozem-likes (Blacks albic)	Albic Phaeozems (PHa)	Phaeozems Albic (PHab)
70	Chernozem-likes (Blacks surface- gleyed)	Stagnic Phaeozems (PHj)	Phaeozems Stagni-Epigleyic (PHst-pgl)
71	Meadows heating	Haplic Phaeozems (PHh)	Phaeozems Haplic (PHha)
	SO	ILS OF DRY STEPPE	
72	Dark chestnuts	Haplic Kastanozems (KSh)	Kastanozems Haplic (KSha)
74	Dark chestnuts meal-calcareous	Calcic Kastanozems (KSk)	Kastanozems Calcic (KScc)
75	Dark chestnuts meal-calcareous contactly-meadowish		
76	Dark chestnuts meal-calcareous residual- meadow		
77	Dark chestnuts meal-calcareous and noncalcareous shallow	Haplic Kastanozems (KSh)	Kastanozems Haplic (KSha)
78	Chestnuts typical		
79	Chestnuts meal-calcareous shallow	Calcic Kastanozems (KSk)	Kastanozems Calcic (KScc)
80	Chestnuts meal-calcareous without subdivision (chestnuts leached)		
81	Chestnuts weakly developed on loose sands	Mollic Leptosols (LPm)	Leptosols Mollic (PLmo)
82	Chestnuts solonchakous	Luvic Kastanozems (KSl)	Kastanozems Sodic (KSso)
83	Chestnut-likes	Haplic Kastanozems (KSh)	Kastanozems Haplic (KSha)
85	Meadow-chestnuts (Chestnuts meadow)	Haplic Phaeozems (PHh)	Phaeozems Gleyic (PHgl)
86	Meadow-chestnuts meal-calcareous	Calcaric Phaeozems (PHc)	Phaeozems Calcaric-Gleyic (PHca-gl)
87	Meadow-chestnuts meal-calcareous heating		Phaeozems Calcaric (PHca)
89	Sands aeolian grassland	Haplic Arenosoils (ARh)	Arenosoils Haplic (ARha)
90	Sands aeolian meadow	1	



MapI



CONCLUSION

The digital coverage "Dominant Soils" for Amur River basin has been compiled. It covers bordering territories of Russia, China, and Mongolia. The digital coverage enables us to analyze the soil cover of Amur River basin as a whole. It helps us to disclose geographical patterns of soil distribution within the basin and specific characteristics of different parts of the basin.

When compiling the digital coverage "Dominant Soils", the data from the source soil maps of Russia, Mongolia, and China was preserved in the fullest, and the soil cartographic material was unified. All the data was coded and added to the database.

The resultant soil compendium includes all the diverse soils of Amur River basin (Scale 1:2.5 M). The soils are grouped in accord with landscape and geographical zoning

principle. The soil compendium includes zonal soils (soils of tundra, taiga and coniferousbroadleaved forests; soils of broad-leaved forests and wooded steppe; soils of steppe; soils of dry steppe), mountainous soils, and also such separate groups as hydromorphic, saline, alluvial, and anthropogenic soils.

Russian, Mongolian, and Chinese soil nomenclatures for Amur River basin were correlated. Then the resultant soil nomenclature was correlated to the soil nomenclatures of FAO-UNESCO and the World Reference Base for Soil Resources.

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