

Figures and English Translation from

Tulukhanov, T., et al., "An Evaluation of the Ecological Condition of the City of Zakamensk with the Goal of Determining Environmentally Unfavorable Zones", Geological Institute Siberian Branch Russian Academy of Sciences, Ulan Ude, Buryat Republic, 2000

[Figure 1] Natural-Manmade System (PTS) of the Dzhidinskii Ore Field [p. 50]

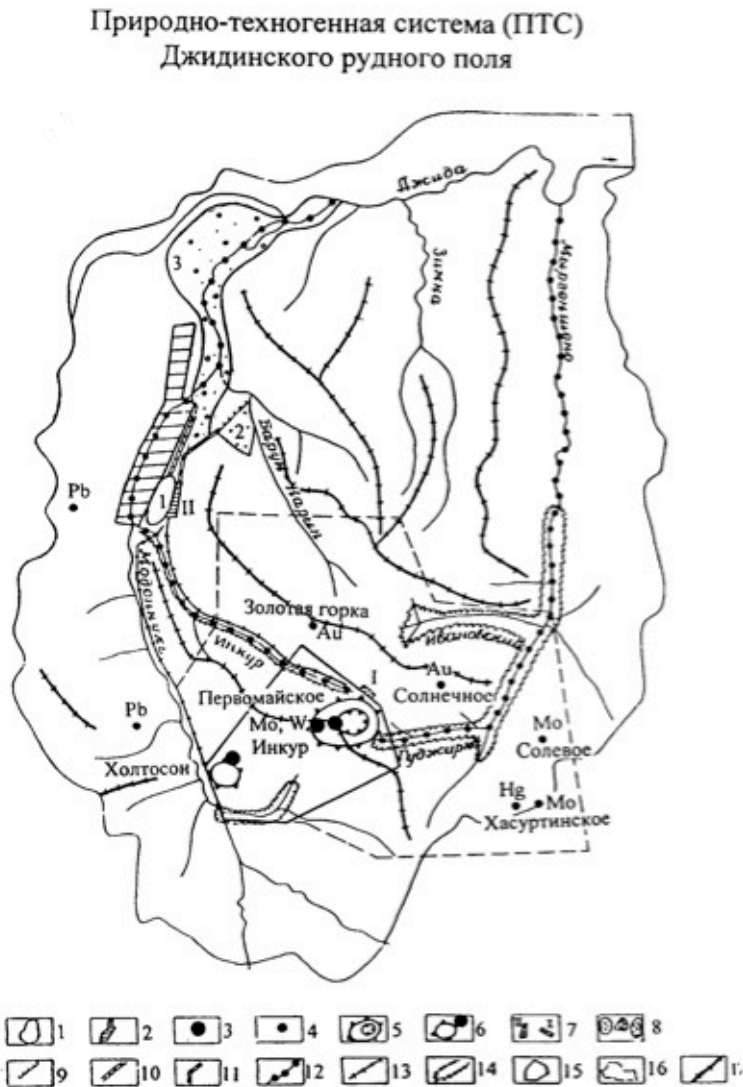


Рис. 1

1- граница ПТС; 2 - г. Закаменск; 3 - месторождения Мо, W, Au; 4 - рудопоявления Au, Mo, Hg, Pb; 5 - карьер Первомайского и Инкурского месторождений и отвалы вскрышных пород; 6 - рудник Холтосон и его отвалы; 7 - фабрики: дробильная (I), обогатительные (II); 8 - техногенные пески: "лежалые пески" (1), "гидроотвал" (2), пролювиально-дельтовый шлейф (3); 9 - плотина гидроотвала; 10 - канава стока аварийных выбросов; 11 - пульпопроводы; 12 - отравленные водотоки; 13 - дороги транспортировки руды к обогатительным фабрикам; 14 - днища долин после отработки россыпей; 15 - земли, на которых проходились тяжелые выработки (штольни, шахты); 16 - земли, на которых проходились легкие выработки (канавы, шурфы); 17 - водораздельные линии

1. boundary of the PTS;
2. city of Zakamensk;
3. deposits of Mo, W, Au;
4. ore development of Au, Mo, Hg, Pb;
5. Quarry of the Pervomaiskii and Inkurskii deposits and slag heaps of exposed rock;
6. Kholton mine and its slag heaps;
7. factories: crushing...I), enrichment...II);
8. manmade sands:
 - (1) "old stale sands",
 - (2) "sludge-pond",
 - (3) proluvial-deltaic trains;
- 9 - sludge-pond dam;
- 10 - drainage ditch for emergency releases;
- 11 - pulp-pipes;
- 12 - poisoned water-flows;
- 13 - roads for transporting ores to enrichment factories;
- 14 - valley bottoms after clearing of alluvial deposits;
- 15 - lands on which heavy excavation occurred (drifts/adits, mines);
- 16 - lands on which light excavation occurred (ditches, test mines/bore pits);
- 17 - watershed demarcations

Figure 2 - Demarcation of territory of Zakamensk along lines of the progression of self-cleansing and pollution. [p. 51]

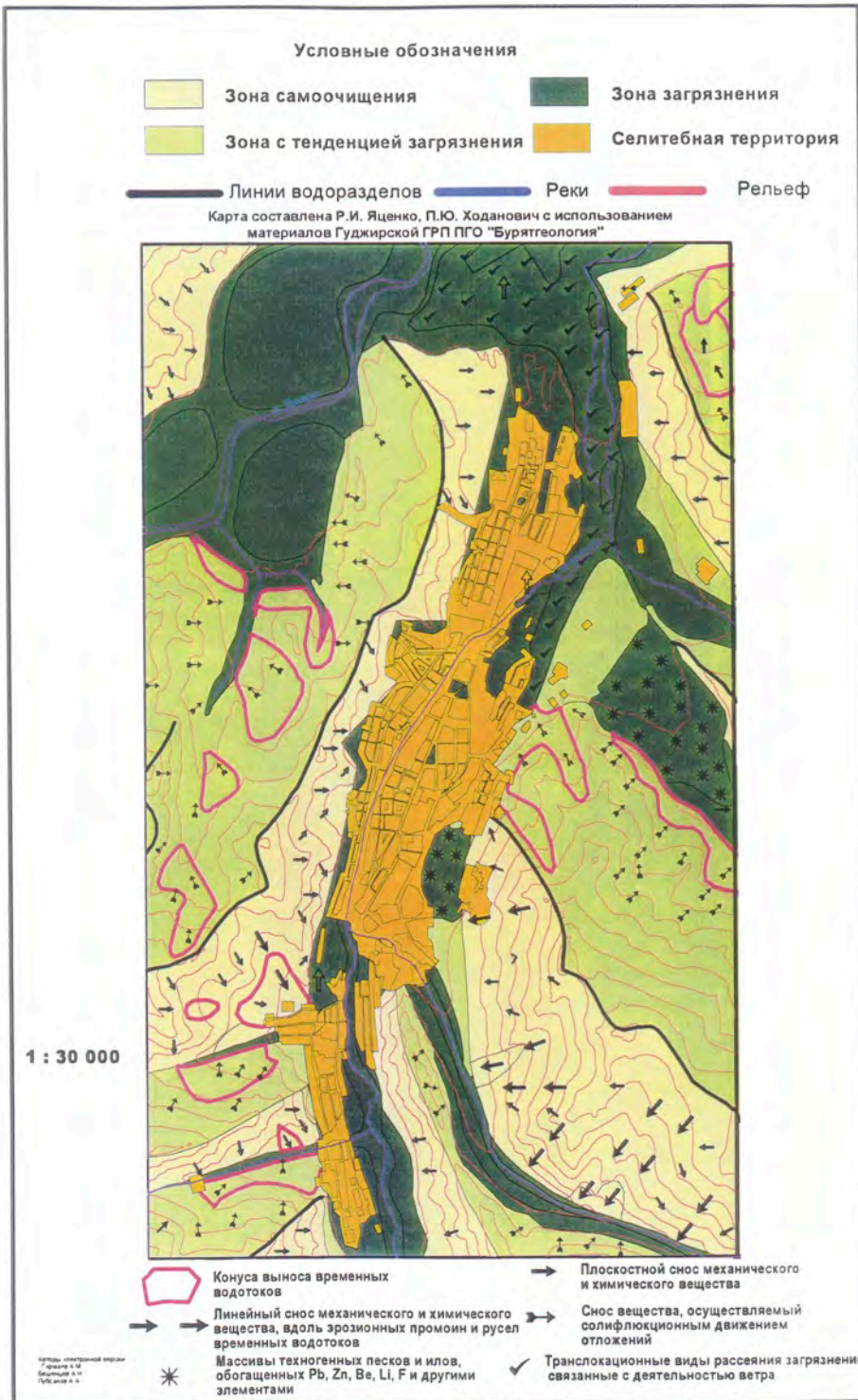


Рис. 2 Районирование территории г. Закаменска по развитию процессов самоочищения-загрязнения

Figure 2 - Demarcation of territory of Zakamensk along lines of the progression of self-cleansing and pollution.

Legend [Above Image]

- | | | | | | |
|---------------|-----------------------------------|--------------|----------------------------------|-------|---------|
| [Yellow] | Self-cleansing zone | [Dark Green] | Contaminated zone | | |
| [Light Green] | Zone tending toward contamination | [Orange] | Settled = residential) territory | | |
| [Black] | - Watershed lines | [Blue] | - Rivers | [Red] | -Relief |

Map compiled by R.I. Yatsenko, P.U. Khodanovich using materials of the Gudzhirskii GRP PGO "Buryatgeology"

Legend [Below Image]

- [Red Polygons] Alluvial fan of temporary water flows
[large black arrows] Planar drift of mechanical and chemical substances

Linear drift of mechanical and chemical substances along eroded ravines and channels of temporary water flows. Drift of substances by solifluctional movement of sediments

- 4 Massifs of manmade sands and silts enriched by Pb, Zn, Be, Li, F and other elements [T]ranslocational views of dispersal of contaminants by wind activity

Figure 3 - Assessment of magnitude of general mineralization in the snow cover in Zakamensk.

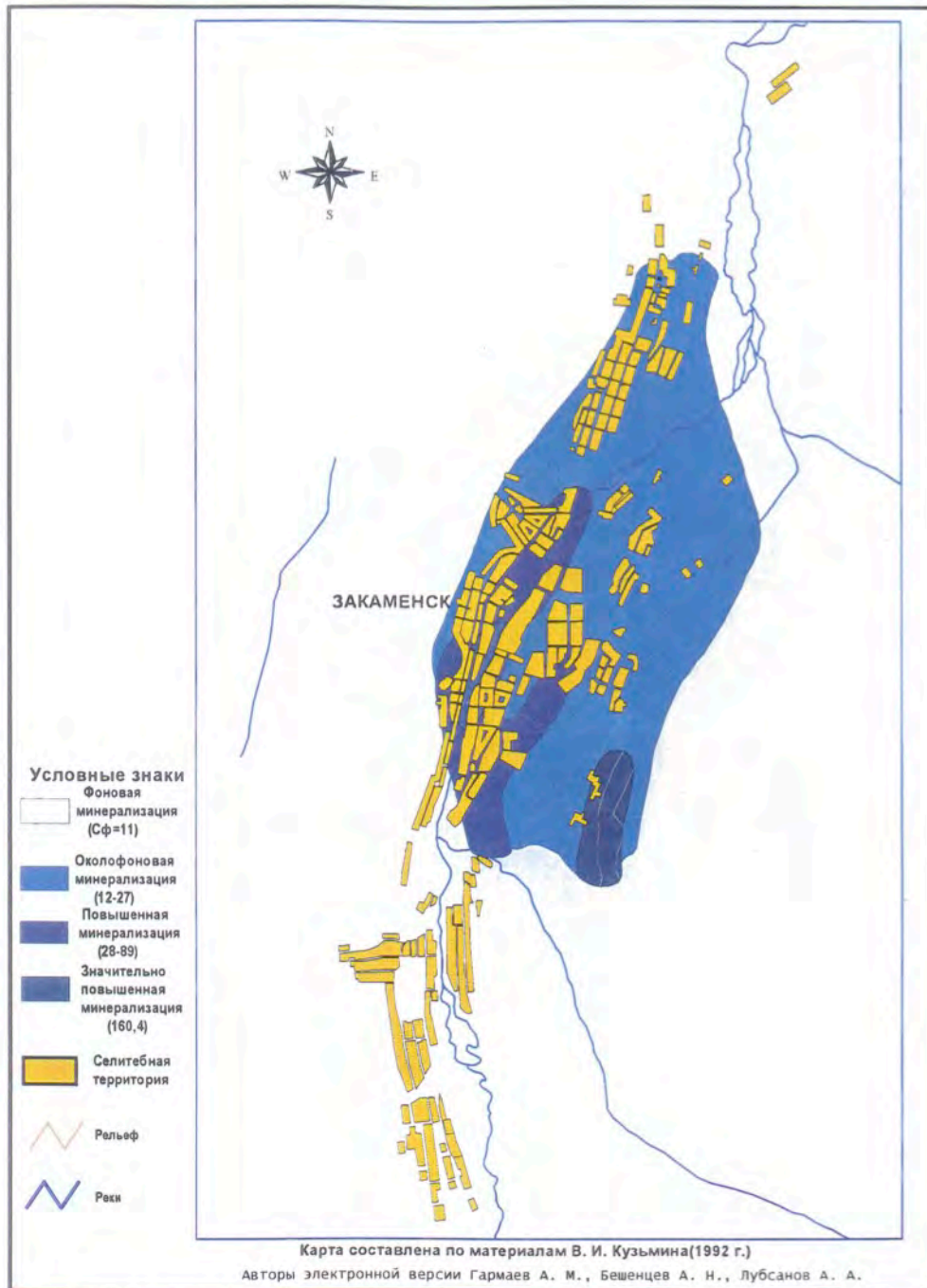


Рис. 3 Распределение величины общей минерализации в снежном покрове г. Закаменск

Figure 3 - Assessment of magnitude of general mineralization in the snow cover in Zakamensk.

LEGEND

- [White] Background Mineralization (Sf = 11) (?Sf = spectrophotometer?)
- [Blue] Near background Mineralization (12-27)
- [Dark Blue] Elevated Mineralization (28-89)
- [Darkest Blue] Significantly elevated Mineralization (160.4)
- [Yellow] Settled - Residential - territory
- [Yellow lines] Relief
- [Blue lines] Rivers

Map compiled from material of V.I. Kuzmin

Figure 4 - Types of snow water in the territory of Zakamensk

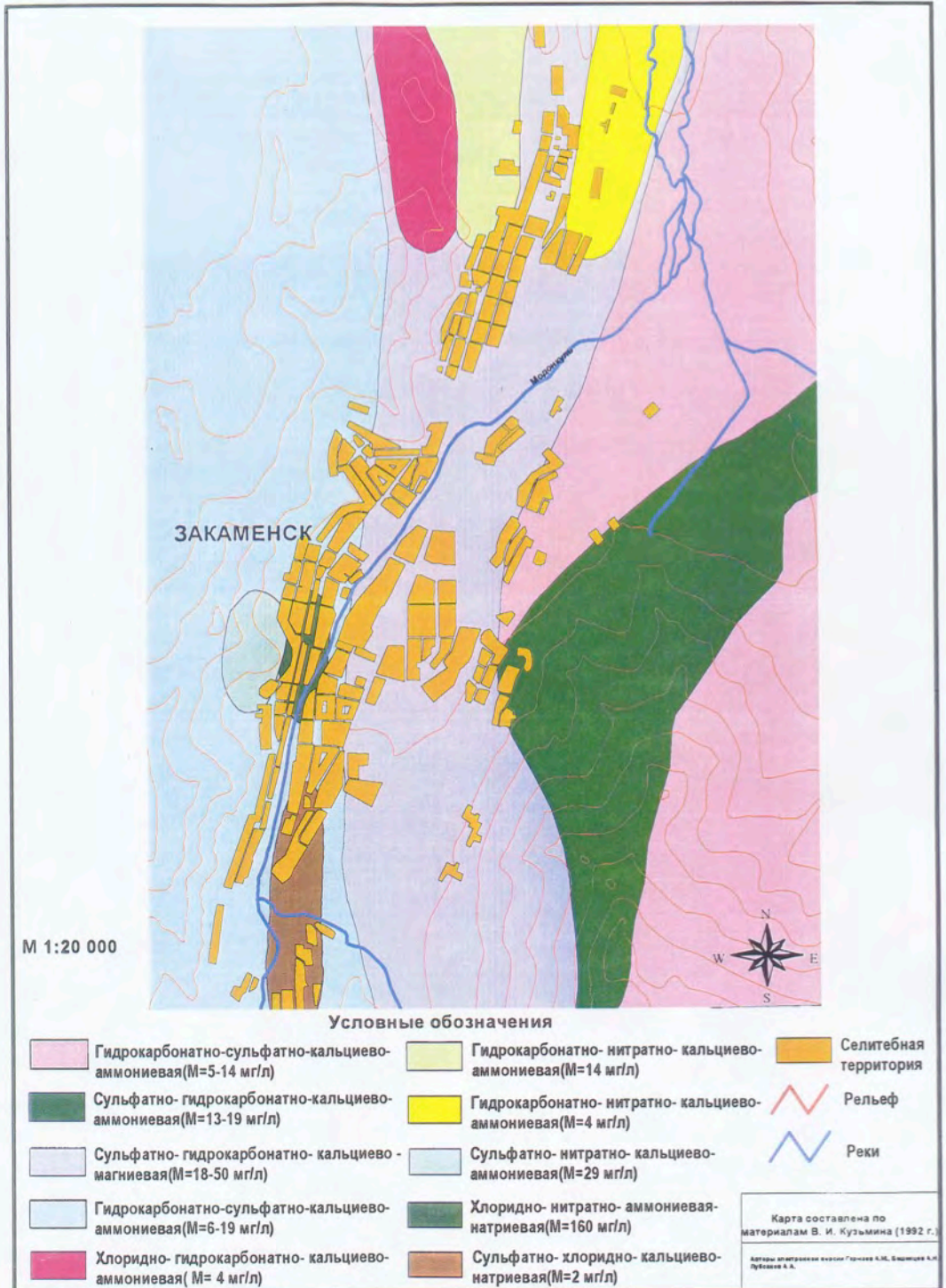


Рис. 4 Типы снеговых вод территории г. Закаменска

Figure 4 - Types of snow water in the territory of Zakamensk

Legend

[Pink] Hydrocarbonate-sulfate-calcium-ammonia(M=5-14 mg/l)	[Light Green] hydrocarbonat-nitrate - calcium-ammonia (M=14mg/l)
[Green] Sulfate-hydrocarbonate-calcium-ammonia(M=13-19 mg/l)	[Yellow] hydrocarbonate-nitrate-calcium-ammonia (M=4mg/l)
[Grey] Sulfate-hydrocarbonate-calcium-magnesium(M=18-50mg/l)	[Light Blue] Sulfate-nitrate-calcium-ammonia(M=29mg/l)
[Light Blue] Hydrocarbonate-sulfate-calcium-ammonia(M=6-19mg/l)	[Dark Green] Chloride-nitrate-ammonia-sodaic(M=160mg/
[Red] Chloride-hydrocarbonate-calcium ammonia(M=4mg/l)	[Brown] Sulfate-chloride-calcium-sodaic (M=2mg/l)

[Right Column]

[Yellow] Settled territory

[Red lines] Relief

[Blue lines] Rivers

Figure 5 - Fields of dispersion of contaminating substances in the vicinity of Zakamensk (Dust from the slag-heaps of the Dzhidinskii tungsten-molybdenum complex)



Рис. 5 Поля рассеивания загрязняющих веществ с окрестностей г. Закаменска (Пыль с отвалов Дзидинского вольфрам-молибденового комбината)

Figure 6 - Fields of dispersion of contaminating substances in the vicinity of Zakamensk. (Dust from the slag-heaps of the Dzhidinskii tungsten-molybdenum complex)

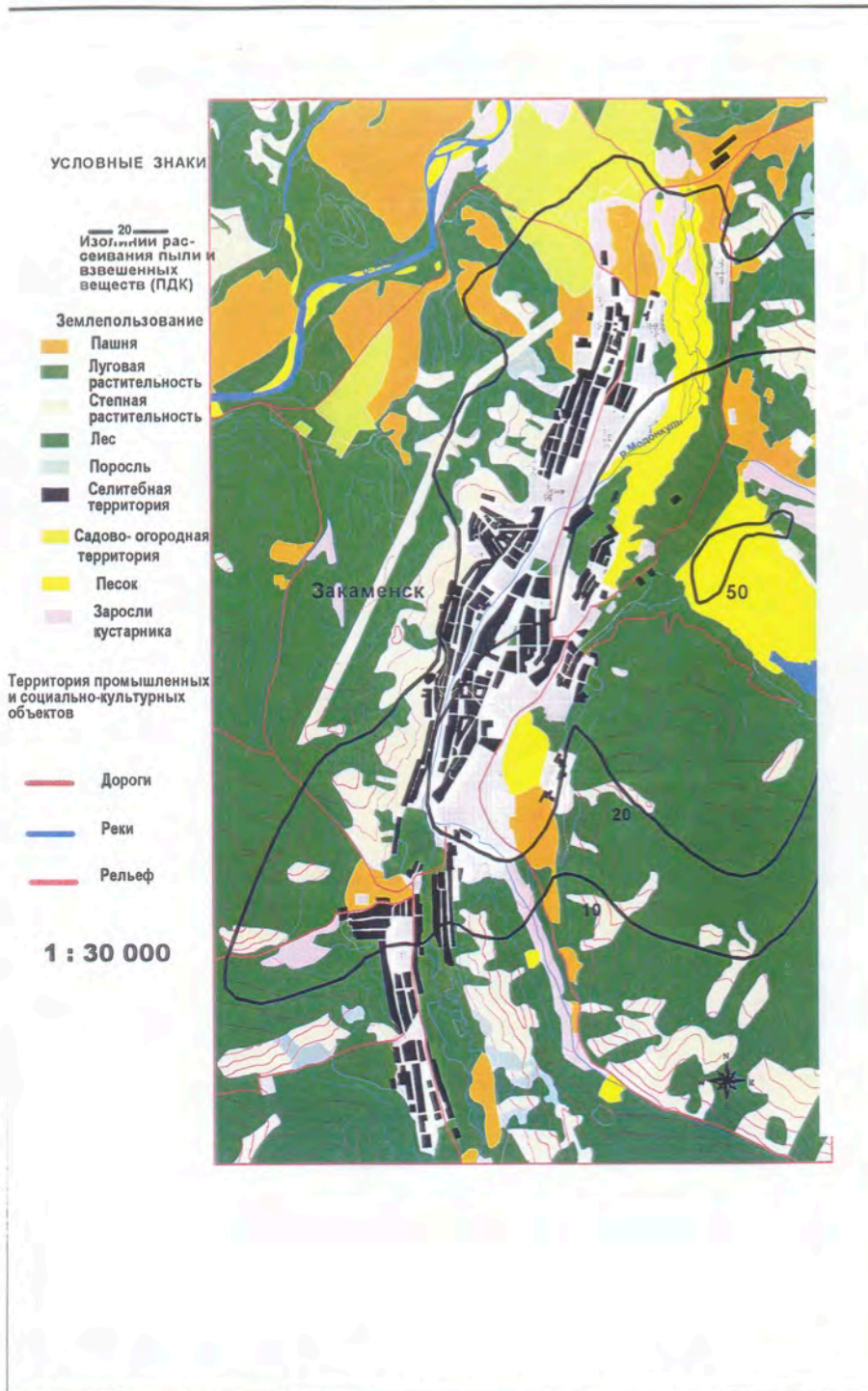


Рис. 6 Поля рассеивания загрязняющих веществ окрестностей г. Закаменска (пыль и взвешенные вещества с отвалов Дзидинского вольфрам-молибденового комбината)

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Figure 6 - Fields of dispersion of contaminating substances in the vicinity of Zakamensk.
(Dust from the slag-heaps of the Dzhidinskii tungsten-molybdenum complex)

LEGEND

[__20__]

Contour lines of dispersion of dust and
suspended particles (PDK)

LAND USE

[Orange] Arable land
[Green] Meadow vegetation
[Grey] Steppe vegetation
[Dark Green] Forest
[Light Blue] Undergrowth
[Black] Settled -Residential - areas
[Green-Yellow] Garden areas
[Yellow] Sand [including old and new tailings and streambed]
[Pink] Shrubbery undergrowth

Areas of industrial and social-cultural units

[Red lines] Roads
[Blue lines] Rivers
Thin Red lines] Relief

Figure 7 - Contaminant concentrations in the Modonkul' river valley caused by man-made tailings

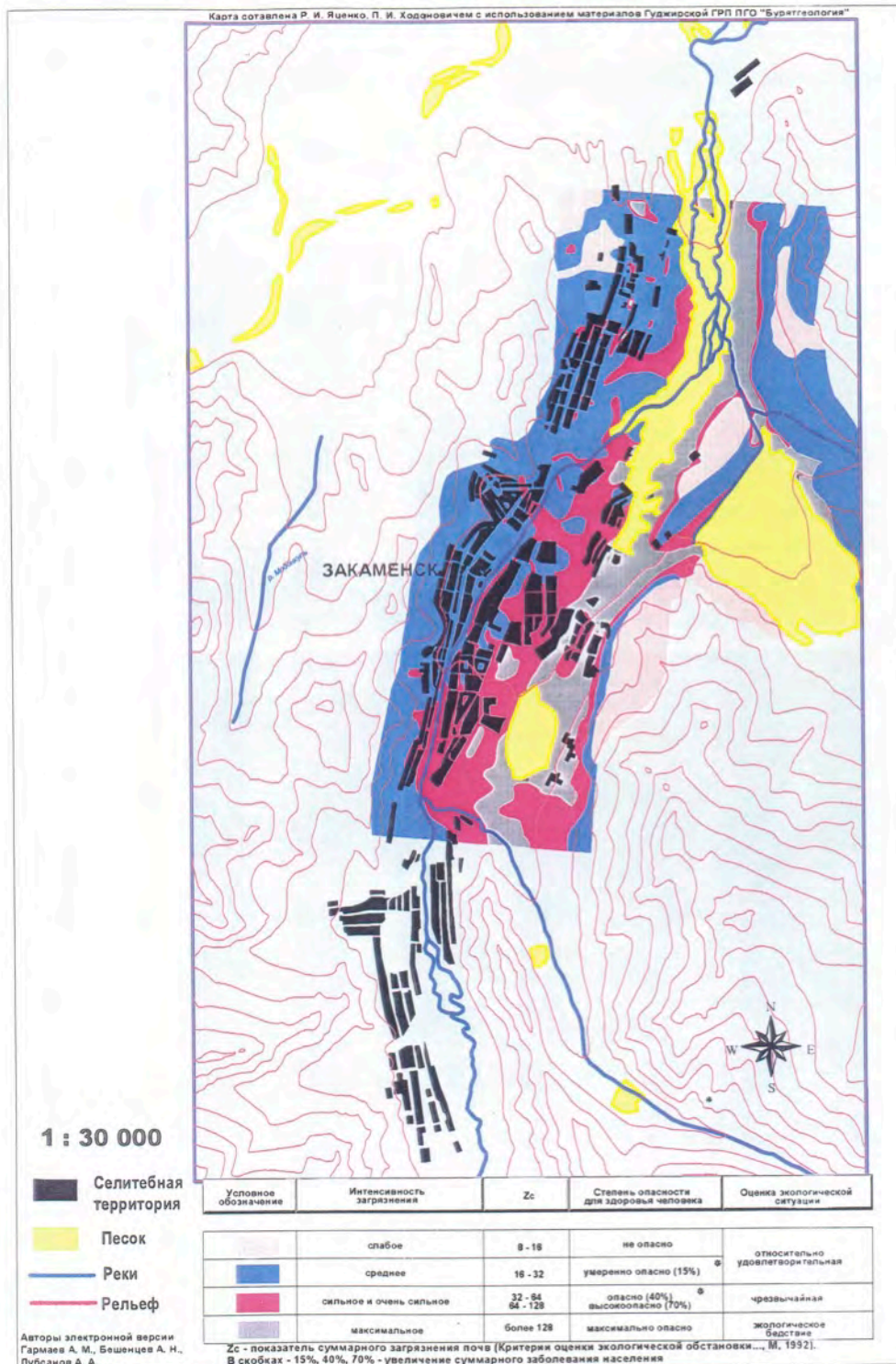


Рис. 7 Интенсивность загрязнения техногенными отходами долины реки Модонкуль 56

Figure 7 - Contaminant concentrations in the Modonkul' river valley caused by man-made tailings

1 : 30 000

[Black] Settled - Residential - Territory

[Sand] Sand

[Blue lines] Rivers

[Red lines] Relief

Legend	Contaminant concentration	Zs	Degree of threat to human health	Appraisal of ecological situation
[Pink]	Weak	8-16	no danger	relatively satisfactory
[Blue]	moderate	16-32	moderate danger* (15%)	relatively satisfactory
[Red]	heavy and very heavy	32-64 64-128	danger *(40%) high danger*(70%)	extreme
[Purple]	maximum	>128	maximum danger	ecological disaster

(Zs - Index of total soil contamination (Criteria of evaluation of ecological conditions., M, 1992)

* - In parentheses - 15%, 40%, 70% - increase in total population illness

Drawing 8 - Prognosis of contamination of territory of Zakamensk by enrichment tailings.

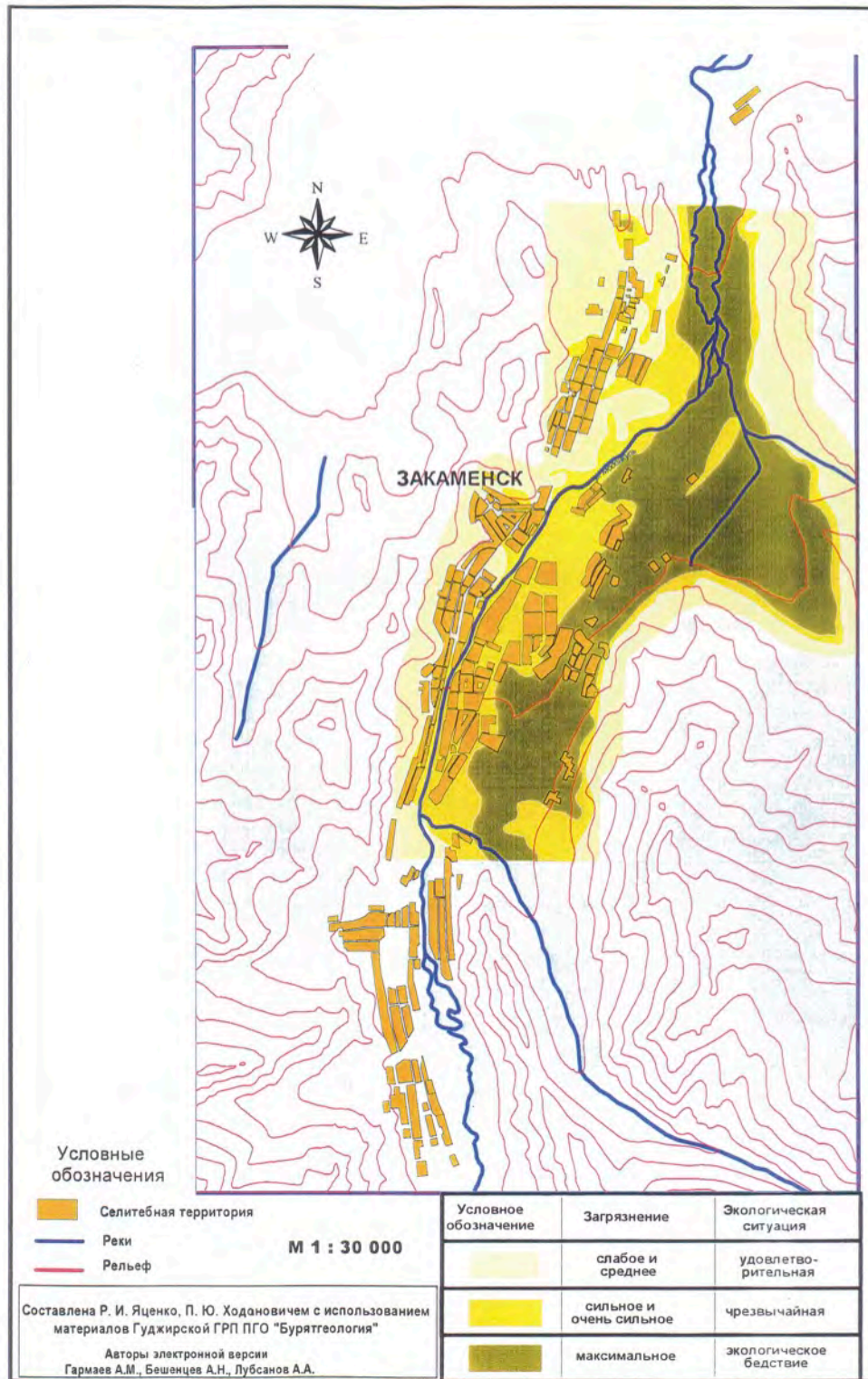


Рис. 8. Прогноз загрязнения отходами обогащения территории г. Закаменска

Figure 8 - Prognosis of contamination of territory of Zakamensk by enrichment tailings.

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	Legend	Contamination	Ecological Situation
[Orange] Settled territory	[[Light Yellow]_____	weak & moderate	satisfactory
Sand	[Yellow]	strong & very strong	extreme
[Blue lines] Rivers	_Green-Yellow]	maximum	ecological disaster
[Red lines] Relief			

Figure 9 - Stray flux of manmade sands according to their radioactivity

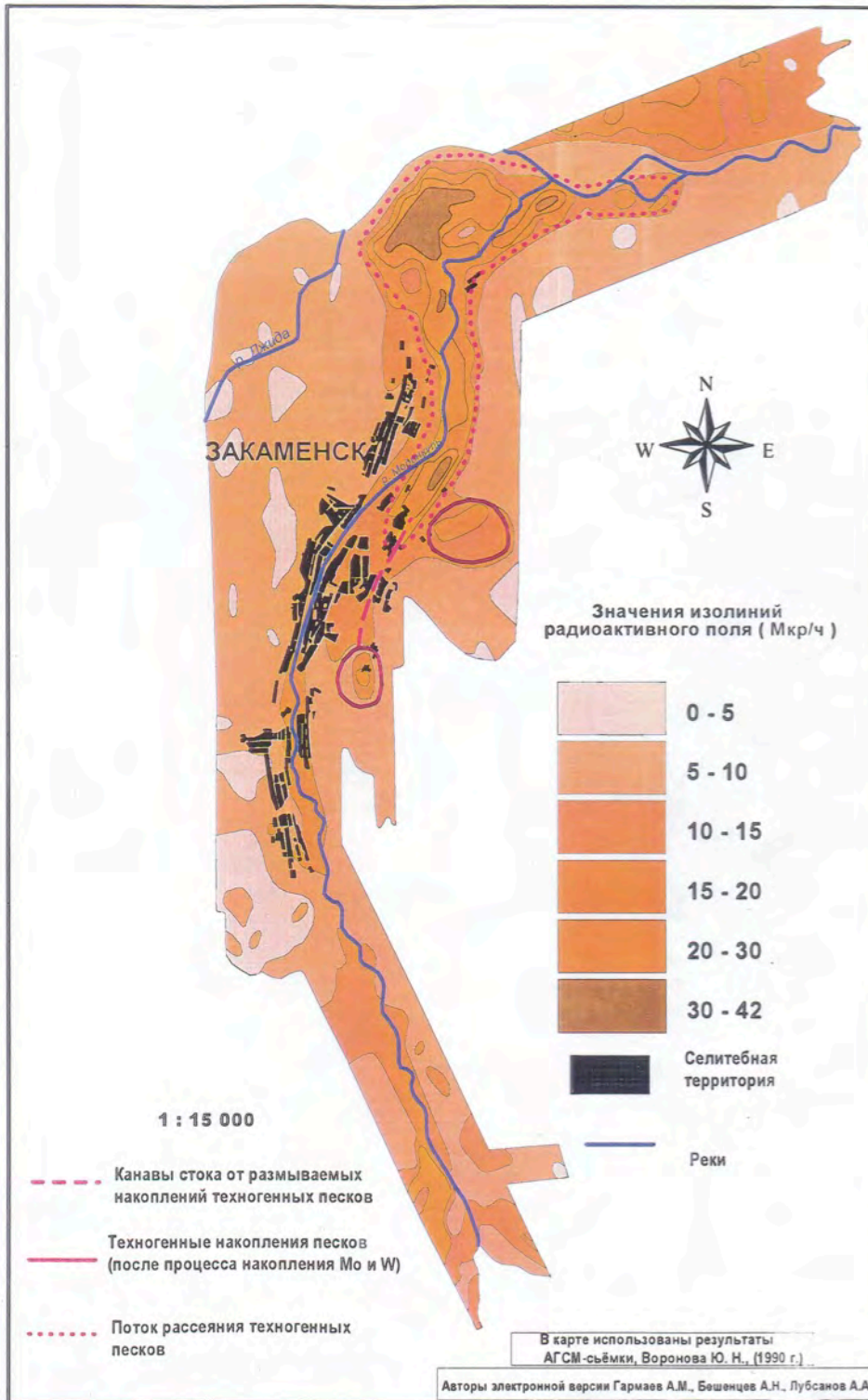


Рис. 9 Поток рассеивания техногенных песков по их радиоактивности

Figure 9 - Stray flux of manmade sands according to their radioactivity

Key to radioactive field contour lines
(micro-roentgens/hr)

[Lightest Orange]	0-5
[Second lightest]	5-10
[Third lightest]	10-15
[Third darkest]	15-20
[Second darkest]	20-30
[Darkest Orange]	30-42
[Black]	Settled territory
[Black lines]	Rivers

----- [Red dashed line] Run-off ditches from eroding
accumulations of manmade sands

— [Red solid line] Manmade accumulations of sands
(post accumulation process of Mo & W)

..... [Red dotted line] Stray flux of manmade sands
Results from the AGSM survey, Yu.N. Voronov (1990)

Figure 10 - Map of medical-ecological zoning of city of Zakamensk according to the ratio of Cu:Mo



Рис.10. Карта медико-экологического районирования г. Закаменска по отношению Cu:Mo

Figure 10 - Map of medical-ecological zoning of city of Zakamensk according to the ratio of Cu:Mo

Legend

- [Yellow outlined areas] Accumulations of man-made sands
- [Orange] Settled territory
- [(1)] "Stale sands" - ["old tailings"]
- [(2)] Sludge pond - ["new tailings"]
- [(3)] Fluvial accumulations - [tailings transported by erosion into streams flood plains]
- [Red lines] Relief
- [Blue lines] Rivers

Legend	Ratio of Cu:Mo in friable deposits	correction factor 1/3 for Cu	Cu:Mo in relation to incidence of gout	Medical- situation
[Light Blue]	(40-26) : 1	11 : 1		satisfactory
[Blue]	(25-16) : 1	7 : 1		
[Light Yellow]	(15-11) : 1	4 : 1	Norm	relatively stressed
[Yellow]	(10-6) : 1	(3-2) : 1		significant stress
[Dark Blue]	(5-3) : 1	(1.7-1) : 1	mining gout	extreme stress
[Purple]	1 : 1	1 : 3	health threat	ecological disaster catastrophe