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Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

# Х А Б А Р Л А Р Ы

## ИЗВЕСТИЯ

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## NEWS

OF THE ACADEMY OF SCIENCES  
OF THE REPUBLIC OF KAZAKHSTAN  
Kazakh national research technical university  
named after K. I. Satpayev

### ГЕОЛОГИЯ ЖӘНЕ ТЕХНИКАЛЫҚ ҒЫЛЫМДАР СЕРИЯСЫ



### СЕРИЯ ГЕОЛОГИИ И ТЕХНИЧЕСКИХ НАУК



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**A. S. Madibekov<sup>1</sup>, A. S. Nysanbaeva<sup>2</sup>, M. S. Kurmanova<sup>2</sup>**

<sup>1</sup>LLP «Institute of Geography», Almaty, Kazakhstan,

<sup>2</sup>Al-Farabi KazNU, Kazakhstan, Almaty.

E-mail: madibekov@mail.ru, ayman.nysanbaeva@kaznu.kz meruert.kurmanova@mail.ru

## **ROLE OF THE CHEMICAL COMPOSITION OF AN ATMOSPHERIC PRECIPITATION IN POLLUTION OF A SURFACE WATER**

**Abstract.** Atmospheric precipitation, which is the main mechanism for self-purification of the atmosphere, takes part in the cycle of substances contained in the atmosphere. A considerable part of them is deposited on the underlying or water surface. At the same time, they can be a valuable source of information on the arrival of pollutants on the Earth's surface. In this article, we tried to establish the relationships between the chemical parameters of atmospheric precipitation and surface waters from observations of stations located in the Ile-Balkash basin, based on data from the Almaty City Monitoring Center.

**Keywords:** atmospheric precipitation, heavy metals, anions, cations, surface water.

**Introduction.** Atmospheric precipitation plays an important role in the formation of chemical composition of natural waters. Atmospheric precipitation, on the one hand, is the source of chemical elements in the atmosphere, and, on the other hand, enrichment of natural waters with chemical elements in the interaction with precipitation and water. Assessment of the role of precipitation in the formation of the surface chemical composition of surface waters is of great importance to the functions of the water ecosystem. This assessment can be conducted in two ways: 1) the concentration changes in atmospheric precipitation can be calculated by the method of S.P.Kitayev in different climatic zones depending on the amount of precipitations and evaporation; and 2) average equivalents from the catchment area can be determined in comparison with the chemical composition of atmospheric precipitations in the Ili-Balkhash basin territory.

The role of chemical composition of precipitation pollution in surface water adversely affects the agricultural and other areas of human activity in the region. Surface water contamination is caused by the increased work of the industry due to the human and economic needs and so on. due to the reasons, is growing significantly nowadays compared to the 20th century. Therefore, when evaluating surface water contamination, knowing the past, present and future nature of precipitation chemical composition is important in evaluating, predicting and applying measures. The assessment of the role of the chemical composition of precipitation in surface water pollution is a key issue in meteorology and hydrology. Currently, the chemical composition of precipitation is widely discussed as one of the topical themes. Atmospheric precipitations are a major factor in surface and underground water formation. Atmospheric water is chemically insufficiently studied. Some toxic substances stored in the oceans throughout the year endanger sea fossils and people's health. Knowing the various additives contained in precipitation is important for agrochemicals, hydrochemicals, hydrogeologists and geochemists to investigate and treat surface and surface water, surface soil surface and preventive measures.

**Object of research.** The Ili River was taken as a study area. Data on meteorological stations polluted by atmospheric precipitation were obtained in 2000-2011 on the river. The Ili River is one of the main rivers in Kazakhstan. The Ili River basin is located on the territory of Almaty and Taldykorgan regions and China. The Ili River is composed of the Tekes and

Kunges rivers. The river lies in a very large area, between 74-84<sup>0</sup> east longitude and 43-46<sup>0</sup> north latitude. The total area of the river basin is 125,000 hectares. The starting point of the Tekes is 1,149 km, and is 1001 km from the origin of the Tekes and Kunges. In Kazakhstan, the length of the river is 815 km. It starts from the Tian Shan mountains in the east and falls into the Balkhash lake. The catchment area is 140 thousand km<sup>2</sup>. The total area of the Ili River basin is approximately 140,000 km<sup>2</sup>, of which approximately 62,600 km<sup>2</sup> (45%) are Chinese territory and 77,000 km<sup>2</sup> (55%) of the Kazakh land. From the origin of the Tekes River, the total length is 1439 km, the territory of Kazakhstan - the main stream is located in China. It has a geographical web (0.6-3 km/km<sup>2</sup>).

The Ili River begins at the Central Tengri, in the People's Republic of China (PRC) after the addition of three rivers (Kash, Kunes and Tekes). The Tekes River has a large source area and its watershed (Halyshtau and Narat ridges) is characterized by a large amount of atmospheric precipitations (over 1300 mm/year). The river basins of the Tekes are located on the territory of the Ice Glacier in Kazakhstan (Kyrgyz - Ice Mountain). The upper left part of the Ili River is located at an altitude of 3500 m on the north-eastern slope of the Teriskei Alatau ridge. The length of the river is 438 km, the catchment area is 28 100 km<sup>2</sup> (218 km and 4250 km<sup>2</sup> respectively). In the upper streams, the Ili River flows into the irrigation of its numerous streams at the intersection of the Tekes hollow, but after the inflow of Khan-Tengri glacier snow water - Kakpak, Bayinkol and Narynkol, the river's water volume is substantially increased. It is then included in the territory of the Eastern Turkestan (China), where the Sun and Kash rivers are being poured, and the Ili River, which is surrounded by the waters of the rivers (250 km). Hydrographic scheme of the Ili basin is shown in the figure 1.



Figure 1 – Hydrographic scheme of the Ili River basin

**Research methods.** The chemical composition of rainfall is important while describing the level of pollution of the atmosphere layer. The chemical composition of atmospheric precipitations characterizes the level of pollution of the atmospheric layer, which precipitates in the cloud.

Precipitation samples are determined on the stations by means of certain devices and methodologies. Precipitation samples may vary depending on the collection duration and the specific conditions:

a) Individual sampling, one or more sampling during one precipitation; the pH value and the proportion of these samples are measured at electrostatic precipitations, and the information obtained can be operatively used;

b) It is the sole probability of precipitation, relative to liquid and solid precipitation. Gathering duration lasts from several minutes to several hours;

c) Monthly aggregate samples include all types of precipitation per month.

Atmospheric sediment sampling is carried out at meteorological stations in rural and urban areas or industrial areas. Part of these meteo stations is part of the World Meteorological Organization's (WMO) International Monitoring System for Atmosphere Air Pollution. The atmosphere pollution monitoring system is conducted in the areas with minimal contaminated areas (meteorological stations) and areas where human activity is more active. That is, as the human farming activity becomes more active, increasing or decreasing the environmental burden can change.

It is necessary to limit the access of different foreign substances to the sample. The sample should be withdrawn from the first precipitation and that is why continuous monitoring should be carried out. The sampling is divided into time and cumulative. For this reason, single-layer samples are taken at individual atmospheric precipitations or snow. The total sample includes samples taken within months, weeks or days. The cumulative test shows only the average values of the components identified over a given period of time. For the sake of withdrawal, the sediment samples should be taken from the first desiccated sediments. Continuous monitoring of atmospheric precipitations is required as the sampling has to be obtained from the initial precipitation.

**Result of the research.** In the water, the salts are found to be ionic. In natural waters, hydrocarbonate  $\text{HCO}_3^-$ , chloride-  $\text{Cl}^-$  and sulfate  $\text{SO}_4^{2-}$  anions and calcium  $\text{Ca}^{2+}$ , magnesium  $\text{Mg}^{2+}$ , sodium  $\text{Na}^+$  and potassium  $\text{K}^+$  dominate and are referred to as the main ions. Chloride ions are salty, sulfate, calcium and magnesium ions are bitter in the water, and the ion is hydrated. These ions are more than 99% of all the dissolved in freshwater at 90-95%, in highly mineralized waters. The concentration of water in the natural state of the basic ions does not exceed 1 mg/l, so the major components of the sea and groundwater are  $\text{Br}^-$ ,  $\text{Sr}^{3+}$ . The surface chemical composition of the surface water varies by climatic and other conditions, and has its own characteristics.

Table 1 – Anion ratio in Kapchagai precipitation and water (2001-2011)

Object	Year	$\text{SO}_4$			$\text{NO}_3$			Cl		
		pr-n	water	%	pr-n	water	%	pr-n	water	%
Kapchagai	2001	4,64	93,58	2,6	1,29	0,87	79,0	6,31	5,19	64,4
	2002	4,40	59,47	3,9	0,97	0,59	87,0	3,55	6,56	28,7
	2003	3,53	73,70	2,5	0,37	0,52	38,0	2,01	9,10	11,7
	2004	7,10	68,83	5,5	0,63	0,88	38,0	3,13	3,13	52,9
	2005	4,36	88,63	2,6	1,43	0,98	77,3	3,10	6,56	25,0
	2006	3,74	66,37	3,0	1,48	0,98	79,8	3,11	3,35	49,2
	2007	7,84	54,89	7,6	1,14	0,89	68,5	2,25	6,26	19,1
	2008	9,62	81,70	6,2	3,11	0,53	310,4	2,91	4,64	33,2
	2009	6,02	79,77	4,0	1,22	0,61	106,4	2,54	18,79	7,2
	2010	3,15	86,52	1,9	0,82	0,57	75,8	1,54	23,97	3,4
2011	5,03	79,39	3,4	2,30	0,66	185,3	2,94	25,97	6,0	

Table 1 shows the percentage of ion concentration (mg/l) in sediments and water and their relationships in percentages. The ratio of ion concentration to precipitation in the rainfall  $\rho = \frac{KC_{pr-n}}{C_{surf.water}}$  was determined by method of S.P.Kitaev (Китаев С.П. Основы лимнологии для гидробиологов и ихтиологов. Петрозаводск Карельский научный центр РАН, 2007. – 395 с.) mentioned above. Where:  $C_{pr-n}$ ,  $C_{surf.water}$  – concentration of atmospheric precipitations and surface water; k-0,53 coefficient which counts evaporation.

The concentration of sulfate ions in the natural water is between 0.2 and 100 mg/l. The minimum concentration of sulfate ions is observed at atmospheric precipitation in the amount of 2 mg/l on average. In the atmospheric precipitation, although the sulfate ion is small in size, it is the main source of sulfate ion transport in surface water. 2001-2011 the concentration of water sulfate ( $\text{SO}_4^{2-}$ ) in the range of 54.89-93.58 mg/l, in rainfall within the range of 3.15-9.62 mg/l. The sulfate ions in the rainfall affected the water by 1.9-7.6%.

Nitrogen  $\text{NO}_3^-$  - in the form of nitrates, with precipitation. The nitrate ion ( $\text{NO}_3^-$ ) was higher in water than rain. The concentration in the water ranged from 0.52 to 0.9 mg/l, the concentration in the rainfall varied from 0.37 to 3.11 mg/l, and in percentage to 38-310.4%. 2001-2011 as the nitrate concentration is high in the rainfall, it added a 100% concentration of nitrate in the water.

Nitrate was higher in water than in precipitation. In 2008 the maximum concentration was 3.11 mg/l and in 2011 it was 2.3 mg/l. The maximum water concentration in 2006 and 2005 was about 0.98 mg/l.



The minimum concentration of nitrate was observed in precipitation and water in 2003. Precipitation was 0.37 mg/l in water and 0.51 mg/l in water. In the years 2001, 2002, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, the concentration of nitrate in the precipitates is likely to be 100% in the nitrogen concentration in the water.

Chloride ion, as mentioned above, is the natural ion source in the water. The concentration in the water varies from 0.1 mg/l in the arctic snow to 150 mg/l in solution. The average concentration of atmospheric precipitation does not exceed 1 mg/l. Chlorides are well melted and evaporated in water, only in small quantities when the water drops. Because it does not depend on ion exchange, adsorption, and biological factors, chlorides solution is very difficult to extract from the water through natural processes. Chloride ions in water 2001-2011 3,13-25,97 mg/l, and in the rainfall at 2,01-6,31 mg/l. It also exceeds the average natural concentration in rainfall. The percentage ratio of chloride concentration in the rainfall to the water content ranged from 3.4 to 64.4%.

Table 2 – Kapchagai precipitation and water cation ratio (2001-2011)

Object	Year	Na+K			Mg			Ca		
		pr-n	water	%	pr-n	water	%	pr-n	water	%
Kapchagai	2001	3,66	25,33	7,7	0,61	18,98	1,7	4,93	42,45	6,2
	2002	2,33	23,20	5,3	0,84	10,48	4,2	2,51	40,08	3,3
	2003	1,43	44,48	1,7	0,48	10,44	2,4	2,44	32,22	4,0
	2004	1,74	21,37	4,3	0,84	23,70	1,9	2,77	33,33	4,4
	2005	3,03	26,97	6,0	1,16	16,10	3,8	2,54	45,17	3,0
	2006	2,13	23,65	4,8	1,15	16,14	3,8	2,24	39,14	3,0
	2007	2,52	21,60	6,2	1,55	17,60	4,7	2,82	43,83	3,4
	2008	2,64	19,52	7,2	1,83	18,56	5,2	4,60	40,88	6,0
	2009	2,83	23,72	6,3	0,93	21,72	2,3	2,72	38,55	3,7
	2010	1,30	30,47	2,3	0,60	17,59	1,8	1,65	44,30	2,0
	2011	2,00	33,00	3,2	1,00	21,65	2,4	3,10	41,40	4,0

In all natural waters, sodium and potassium ions ( $\text{Na}^+ + \text{K}^+$ ) are present in a certain quantity. Sodium ion is 1 to 20 mg/l in water and 10 mg/l of potassium ion. Water concentration of sodium and potassium in Kapchagai check point for 2001-2011 years is 19.52-44.48 mg/l, precipitation concentration in the range of 1.30 to 3.66 mg/l. Its concentration in rainfall was 1.7 to 7.7% percent water percentage.

Magnesium ions ( $\text{Mg}^{2+}$ ) are close to calcium in terms of geochemical composition. The dissolution of magnesium carbonate directly depends on the presence of carbon dioxide. Magnesium concentration in water is between 1-40 mg/l. The magnesium concentration in the water was 10.44-23.70 mg/l in the water and 0.60-1.83 mg/l in the rainfall. The ratio of precipitation to water was 1.7-5.2 %. Magnesium ions have low concentrations in rainfall than water.

Calcium ion ( $\text{Ca}^{2+}$ ) is one of the most common cations in natural waters. Surface water is at a concentration of 20-30 mg/l, when saturated with atmospheric carbon dioxide ( $\text{CO}_2$ ). The concentration of calcium ion in the surface water increases up to 40-50 mg/l by hydrocarbonate, carbon dioxide and calcium carbonate. Calcium content in Kapchagai water was 32.22-45.17 mg/l, and the precipitation rate was 1.65- 4.93 mg/l. The amount of calcium ion in water was 2-6.2 percent.

Magnesium ions are found in all natural waters. In natural waters, calcium is encountered by the lime and gypsum flooding. Calcium in natural water does not exceed 1 g/l. As the mineralization grows, magnesium and calcium grow.

We see that magnesium ions are less concentrated in rain than in water. The maximum concentration of water in 2004 was 23.7 mg/l, with a minimum concentration of 2003 and 10.4 mg/l in 2004. The magnesium ion content in the precipitation was 1.83 mg/l in 2008, with a minimum concentration of 0.48 mg/l in 2003. The magnesium ion content in precipitation increased by 1.7 % in 2001, 4.2 % in 2002, 2.4 % in 2003, 1.9 % in 2004, 3.8 % in 2005, 3.8 % in 2006, 4.7 % in 2007, 5.2 % in 2008, 2.3 % in 2009, 1.8 % in 2010 and 2.4 % in 2011.

Calcium ion is very small in precipitation than in water. The maximum concentration of calcium in water in 2004 was 23.7 mg/l, with a minimum of 10.4 mg/l in 2002 and 2003. Precipitation is low in calcium all over the years. The share of precipitation on calcium ion in the water ranges from 2-6.2 %.

Table 3 – Precipitation and water anion ratio in Zhidely hydropower station

Object	Year	SO <sub>4</sub>			NO <sub>3</sub>			Cl		
		Pr-n	Water	%	Pr-n	water	%	Pr-n	water	%
Zhidely	2003	33,74	74,40	24,0	0,61	0,49	66,3	21,11	12,93	86,6
	2004	44,26	74,90	31,3	1,42	0,43	173,7	17,56	6,70	138,9
	2005	37,67	93,61	21,3	1,79	0,83	114,3	13,66	6,37	113,6
	2006	27,00	64,02	22,4	2,41	0,70	183,4	14,73	2,25	347,9
	2007	50,72	76,80	35,0	1,58	0,76	109,8	18,33	3,01	322,5
	2008	61,18	104,10	31,1	3,85	0,39	519,2	21,64	3,90	294,1
	2009	34,28	56,02	32,4	1,76	0,63	148,5	13,76	21,37	34,1
	2010	21,90	96,07	12,1	1,64	0,66	131,3	10,41	31,90	17,3
	2011	30,68	67,98	23,9	3,45	0,08	2314,6	9,91	24,65	21,3

As can be seen in the table 3, the concentration of sulfate in atmospheric precipitation is estimated at Zhideli station in 2003-2011 years are 21,90-50,72 mg/l and in water at 56,02-104,10 mg/l. As the sulfate concentration in the precipitation increases, the concentration of sulphate in the water has increased. The impact of rainfall on water varies between 12.1-32.4 %. The maximum concentration of nitrate in precipitation was 3.85 m/l in 2008, with a minimum concentration of 0.61 m/l in 2003. The maximum amount of nitrate in water was 0.83 mg/l in 2005 and the lowest in 0.08 mg/l.

In recent years, chlorine concentration has decreased in precipitation, and water concentration has increased dramatically. High concentrations of chloride ions can be explained not only by natural factors, but also by anthropogenic proportions. If the average concentration of chloride ions in the rainfall on our planet is 1.6 mg/l, then we can speak of chloride ion contamination in the Ili-Balkhash region. The maximum concentration was 31.9 mg/l in 2010, with a minimum concentration of 2.2 mg/l in 2006. The maximum amount of chlorine in the rainfall in 2008 was 21.6 mg/l and the minimum was 2.2 mg/l.

In recent years, the concentration of chlorine has decreased in the precipitation and the concentration of water has increased sharply. Large concentrations of such chloride ions can be explained not only by natural factors, but also by anthropogenic proportions. If the average concentration of chloride ions in the precipitation on our planet is 1.6 mg/l, then we can speak of chloride ion contamination in the Ili-Balkhash region. The maximum concentration was 31.9 mg/l in 2010, with a minimum concentration of 2.2 mg/l in 2006. The maximum amount of chlorine in the precipitation in 2008 was 21.6 mg/l and the minimum was 2.2 mg/l. Chlorine concentration in recent years has declined, but increased in water.

Table 4 – Precipitation and water cation ratio in Zhidely hydropower station

Object	Year	Na+K			Mg			Ca		
		Pr-n	Water	%	Pr-n	water	%	Pr-n	water	%
Zhidely	2003	20,30	75,70	14,2	3,10	17,40	9,4	12,16	12,41	52,0
	2004	21,07	59,60	18,7	4,78	20,14	12,6	16,14	35,28	24,2
	2005	19,56	51,38	20,2	6,00	13,87	22,9	13,92	32,37	22,8
	2006	17,46	25,52	36,3	4,56	14,66	16,5	11,62	38,10	16,2
	2007	24,40	17,60	73,5	6,27	19,46	17,1	15,54	43,23	19,1
	2008	31,40	20,85	79,8	5,22	22,40	12,4	18,89	37,60	26,6
	2009	20	33,78	31,4	5,01	22,93	11,6	15,25	30,57	26,4
	2010	11,17	36,88	16,1	3,55	28,37	6,6	12,58	34,47	19,3
	2011	15,60	23,89	34,6	3,36	27,90	6,4	13,96	34,70	21,3

As shown in the table 4, sodium and potassium are high both in rain and in water. The maximum amount of precipitation in the year was 21.07 mg/l in 2004, and the lowest in 2010 was 11.2 mg/l. The largest amount of water in 2003 was 75.7 mg/l, the lowest in 2007 was 17.6 mg/l. Generally, the sodium and potassium salts from precipitation in the water ranged from 20 to 70, sometimes 100% in water. Magnesium is much larger than precipitation. The highest concentrations of water in 2010 were 28.4 mg/l, and the lowest concentration was 13.9 mg/l in 2005. The maximum magnesium content in the precipitation in 2007 was 6.27 mg/l, with a low concentration of 3.10 mg/l in 2003. The magnesium content of rainfalls in the water was 12.0-43.3%. Calcium content is much higher than precipitation. The maximum water concentration in 2007 was 43.23 mg/l and the lowest concentration was 12.4 mg/l in 2003. The maximum magnesium content in the precipitation in 2008 was 18.9 mg/l, with a low concentration of 11.6 mg/l in 2006. The percentage of precipitations on water in calcium ranged from 16.2-52 %.

**The connection of heavy metals in atmospheric precipitations and chemical composition of water.** Heavy metals include up to 50 atomic units or more than six densities. Ecologically hazardous heavy metals include lead, mercury and cadmium. The Group of Heavy Metals coincides with the concept of "trace elements". Heavy metals are exposed to natural waters not only by the industrial water, but also by rainwater, especially from residual reservoirs, by filtration. It enters into the water medium with other heavy metal components. They are oxyhydrate, ion pairs, organic and inorganic compounds.

Many heavy metals form synergetic additives. They have a toxic effect on the organisms in the water. The following picture shows the heavy amounts of heavy metals in the rain and water (figure 2).

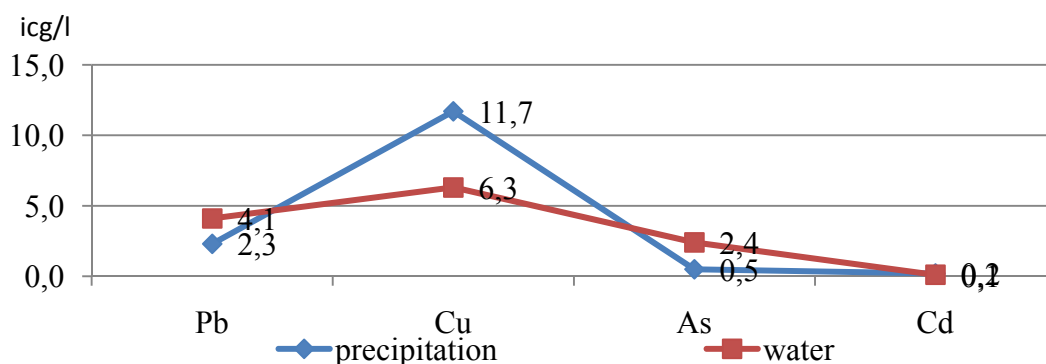


Figure 2 – Concentration of heavy metals in Kapchagai precipitation and water (2000-2011)

The amount of lead (Pb) in the rainfall is 2.3  $\mu\text{g/l}$ , with water concentration equal to 4.1  $\mu\text{g/l}$ . The amount of lead in untreated surface water does not exceed 30  $\mu\text{g/l}$ , lead capacitance in Kapshagay does not exceed concentration. The amount of copper (Cu) in rainfall was 11.7  $\mu\text{g/l}$ , water concentration was 6.3  $\mu\text{g/l}$ . Arsenic (As) precipitated was 0.5  $\mu\text{g/l}$  in water and 2.4  $\mu\text{g/l}$  in water. Cadmium concentration in pumping water can exceed 50  $\mu\text{g/l}$ . The amount of cadmium (Cd) in the rainfall was 0.2 microns/l, which was very small. The concentration in the water was equal to 0.1  $\mu\text{g/l}$  and the limit potential did not exceed concentration. Heavy metals in rainfall and water have a strong correlation coefficient of 0.86. That is, the concentration of heavy metals in rainfall is associated with the concentration of heavy metals in water.

As shown in figure 3, the content of lead (Pb) in precipitation is 2.3 microns/l, with water concentration equal to 4.1  $\mu\text{g/l}$ . The amount of copper (Cu) in the precipitation was 11.7  $\mu\text{g/l}$ , with water concentration equal to 6.3  $\mu\text{g/l}$ . As precipitation was 0.5  $\mu\text{g/l}$  in water, 2.4  $\mu\text{g/l}$  in water, Cd precipitation was 0.2  $\mu\text{g/l}$  and water concentration was 0.1  $\mu\text{g/l}$ . Thus, heavy metal interactions in precipitation and water are dense, and its correlation coefficient is 0.86.

The following picture shows the dimensions of heavy metals in rain and water (figure 3).

As shown in figure 3, the amount of lead in Pb is 3  $\mu\text{g/l}$ , with a water concentration of 2.7  $\mu\text{g/l}$ . The amount of copper (Cu) precipitations was 15.5  $\mu\text{g/l}$ , with water concentration equal to 5.3  $\mu\text{g/l}$ . As precipitation in the precipitation was 0.5  $\mu\text{g/l}$  in water, 1.7  $\mu\text{g/l}$  in water, Cd precipitation was 1.1  $\mu\text{g/l}$  and water concentration was 1.9  $\mu\text{g/l}$ . Due to the concentration of cadmium concentration of 1  $\mu\text{g/l}$ , the Zhidely station exceeded concentration 1.9  $\mu\text{g/l}$ . Thus, according to Aul-4, heavy metals in heavy

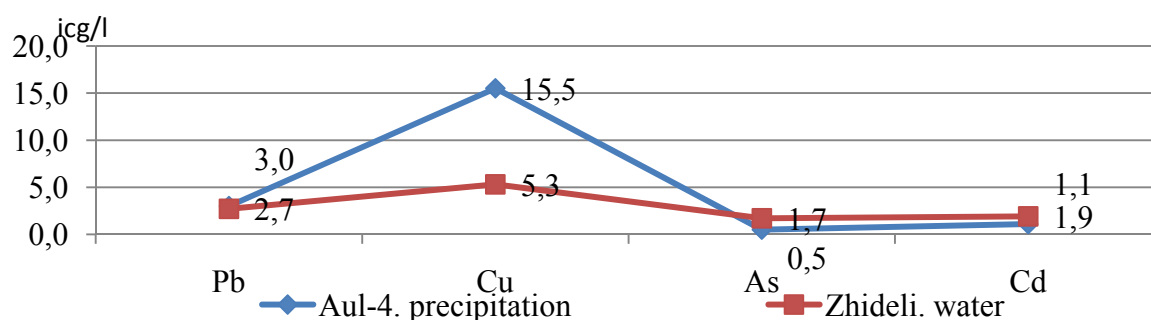


Figure 3 – Concentration of heavy metals in the water at Aul-4 and Zhidely station (2000-2011)

precipitation and precipitation in Jide are very closely linked to the correlation coefficient equal to 1. As the concentration of heavy metals in the atmospheric precipitation increases, the concentration of heavy metals in the water has increased.

**Conclusion.** During the work, it was discovered that the pollutants in the atmospheric precipitation had an effect on the water content. The effect of the anionic and cation content on the water in the rain was very dense. The concentration of the basic ions in water in the natural state (1 mg / l), however, was considerably higher than that of all the anions ( $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$ ,  $\text{Cl}^-$ ) in Kapshagai and Zhidely hydraulic bottles and the cations ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^+$ ,  $\text{Ca}^+$ ).

Kapshagai, Aul-4/Zhideli were found to be very close together with atmospheric precipitations and heavy metals in the chemical composition of water. The concentration of heavy metals (Cu, Cd, Pb) in precipitation increased with concentrations in water. Heavy metals in rainfall and heavy metals are correlated, correlation coefficient is 0.86 in Kapshagai and 1 in Aul-4/Zhideli. The cadmium hydrogen bubble cadmium exceeded the concentration limit of 1.9 µg/l.

Chemical composition of water and precipitation at the Kapshagai and Zhidely weather stations located near Ile-Balkhash, 2001-2011. (Kapshagai) and 2003-2011. (Zhidely), and the pollutants in the atmospheric precipitation have an impact on the water content during the work (see tables 1-3). Kapshagai, Aul-4, Zhidely were found to be very close together with atmospheric sediments and heavy metals in the chemical composition of water. The concentration of heavy metals (Cu, Cd, Pb) in precipitation increased with concentrations in water. The correlation coefficient of heavy metals in precipitation and heavy metals is 0.86 in Kapshagai and 1 in Aul-4/Zhidely.

According to the results obtained in the atmospheric precipitation, the content of anions and cations in the surface water is considerably lower, as is the case with the leaching process.

An important part of the atmospheric precipitations is due to the presence of anthropogenic sources. In addition, soil storage is high, they are not included in water bodies, but remain in the water collection hole. This is particularly concerns to heavy metals.

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**А. С. Мадибеков<sup>1</sup>, А. С. Нысанбаева<sup>2</sup>, М. С. Құрманова<sup>2</sup>**

<sup>1</sup>ТОО «География Институты», Алматы, Қазақстан,

<sup>2</sup>Әль-Фараби атындағы ҚазҰУ, Алматы, Қазақстан

### **БЕТКЕЙ СУЛАРЫНЫҢ ЛАСТАНУЫНДА АТМОСФЕРАЛЫҚ ЖАУЫН-ШАШЫННЫҢ ӘСЕРІН БАҒАЛАУ**

**Аннотация.** Атмосфералық жауын-шашын атмосфераның өзін-өзі тазалау механизміне және атмосферадағы заттардың айналымына қатысады. Жауын-шашынның айтарлықтай көп мөлшері төселме немесе су беткейіне келіп түседі. Сондай-ақ жер бетіне келіп түсетін ластаушы заттар туралы мәліметтер алудағы бағалы көз болып табылады. Берілген мақалада біз Алматы қаласы бойынша Мониторинг Орталығынан Іле-Балқаш бассейні маңында орналасқан станциялардан алынған бақылау нәтижелері бойынша атмосфералық жауын-шашын мен беткей суларының химиялық құрамының арақатынасы анықталды.

**Түйін сөздер:** атмосфералық жауын-шашын, ауыр металдар, анион, катион, беткей сулары.

**А. С. Мадибеков<sup>1</sup>, А. С. Нысанбаева<sup>2</sup>, М. С. Құрманова<sup>2</sup>**

<sup>1</sup>ТОО «Институт географии», Алматы, Қазақстан,

<sup>2</sup>ҚазНУ им. аль-Фараби, Алматы, Қазақстан

### **РОЛЬ ХИМИЧЕСКОГО СОСТАВА АТМОСФЕРНЫХ ОСАДКОВ В ЗАГРЯЗНЕНИИ ПОВЕРХНОСТНЫХ ВОД**

**Аннотация.** Атмосферные осадки, являющиеся основным механизмом самоочищения атмосферы, принимают участие в круговороте веществ, содержащихся в атмосфере. Значительная их часть осаждается на подстилающую или водную поверхность. В то же время могут быть ценным источником информации о поступлении загрязняющих веществ на поверхность Земли. В данной статье мы попытались установить зависимости между химическими параметрами атмосферных осадков и поверхностных вод по результатам наблюдений станций расположенных в районе Иле-Балкашского бассейна, на основе данных Центра мониторинга по городу Алматы.

**Ключевые слова:** атмосферные осадки, тяжелые металлы, анионы, катионы, поверхностные воды.

#### **Information of the authors:**

Madibekov A. S. – Candidate of Geographic Sciences, Head of the Laboratory of Hydrochemistry and Ecotoxicology, LLP «Institute of Geography», Almaty, Kazakhstan; madibekov@mail.ru

Nysanbaeva A. S. – Candidate of Geographic Sciences, al-Farabi KazNU, Kazakhstan, Almaty; auyman.nysanbaeva@kaznu.kz; <https://orcid.org/0000-0003-1611-7775>

Kurmanova M. S. – master of al-Farabi KazNU, by specialty «Meteorology», department of «Meteorology and hydrology», Almaty, Kazakhstan; meruert.kurmanova@mail.ru; <https://orcid.org/0000-0001-9787-9207>

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