International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 08 | Aug 2021 www.irjet.net p-ISSN: 2395-0072

Heavy Metals Contamination in Ground Water of Kashmir Valley

K.S. Rawat[1], Nimay Kashyap[2], Partha Pratim Mondal[3], Vidya Nand Negi[4], M.L.Angurala[5]

[1,2,3,4,5] *Central Ground Water Board, NWHR, Jammu, Jammu & Kashmir, India*

Abstract - *The present investigation has been carried out to assess the presence of Heavy Metals viz. Cadmium, Chromium, Copper, Manganese, Nickel, Lead, Zinc, Iron and Arsenic in Ground water of five districts viz. Budgam, Baramulla, Kupwara, Pulwama and Srinagar in Kashmir valley. These heavy metals are naturally occurring elements and have multiple usages in our lives. Thus their widespread usage has lead to contamination of ground water. The assessment of heavy metals in water is important to estimate the risks posed to human life. With surface water present in form of rivers, springs, lakes, glaciers and streams, the ground water is the also lifeline for the people of valley for domestic, irrigation and horticulture purposes. Ground water plays an important role in development of various sectors such as agriculture, tourism, horticulture, food and industry etc. Total 27 samples were analyzed through Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) technique for heavy metals presence in different parts of Kashmir. All the groundwater samples were found well within the prescribed range of BIS Standards.*

Key Words: **Ground water, Heavy Metals, ICP-MS, Kashmir, ppb**

1. INTRODUCTION

The valley of the Kashmir is one of the ravishing places in the earth. It is rightly said that if there is heaven on Earth, it is Kashmir. The valley of Kashmir has ample source of water. The valley has been accorded with ample source of fresh water resources which comprises of lakes, glaciers, springs, rivers and groundwater. The groundwater is used for the drinking, irrigation and horticulture purposes. However, surge in the population has lead to over exploitation of natural resources. Over dependence on ground water has lead to its depletion in India [1- 2]. With the depletion of ground water as primary concern, the pollution of ground water is also the main issue in the country [3-6]. Kashmir valley has also rich source of groundwater present in confined and unconfined aquifer but its extraction is unbalanced due to different geological formations. The extraction rate of ground water is very less in the valley [7-8]. Therefore, ground water can be utilized to fulfill the demand of drinking and irrigation purposes. However, keeping future demands in the view, the management of ground water is important. The quality of ground water is important as it is utilized for drinking and irrigation purposes. The groundwater should be free from any harmful chemical constituents. This research article assess the level of heavy metals viz. Cadmium (Cd), Chromium (Cr), Copper (Cu), Manganese (Mn), Nickel (Ni), Lead (Pb), Zinc (Zn), Iron (Fe) and Arsenic (As) in Ground water of Kashmir valley. These are naturally occurring elements which have multiple, domestic, industrial, medical, agricultural and technological usage have led to their widespread distribution in the environment. This rapid usage has also in filtered the groundwater thus raising concerns over ingestion of the contaminated water and the potential effects on human health and the environment. These are present in trace amounts i.e. parts per billion to up to 10 ppm and also known as trace elements. They are classified as human carcinogens according to the U.S. Environmental Protection Agency.

These heavy metals are naturally occurring however most of the environmental pollution and human risk are direct result of anthropogenic activities such as mining, industrial, domestic and agricultural use of metals and metal-containing compounds [9-10].

Although the metals such as Copper, Manganese, Zinc, iron are essential for the human body. They are required in body for various biochemical functions. These are classified as micronutrients and their deficiency can lead to diseases [11].

As ground water resources in the Kashmir valley are less developed, this research articles provide the details on the presence of heavy metals.

2. Location

27 ground water samples were collected from the five districts in the Kashmir valley. The samples were collected from Baramulla, Kupwara, Pulwama, Budgam and Srinagar districts. Most of the monitoring stations fell in these districts. Kashmir valley covers an area of about 5600 km and comprises parts of Budgam, Pulwama, Srinagar, Baramulla and Kupwara Districts and the elevation of the valley is between 200 m to 5000 m above mean sea level. The Kashmir Valley is surrounded by high mountains and has distinctive climatic characteristics. The average annual rainfall is 660 mm. the temperature goes around 35ºC during summer. During winter the mercury drops between -8ºC and 12ºC. In December-January the minimum temperature is generally below freezing point [12].

Srinagar district is located in the center of Kashmir valley. It is situated on the bank of Jhelum River. Baramulla district is situated in the Northern and Western boundary whereas Budgam district forms the Western and South – Western limits. In the south, Srinagar district is surrounded by Pulwama district (Fig.1).

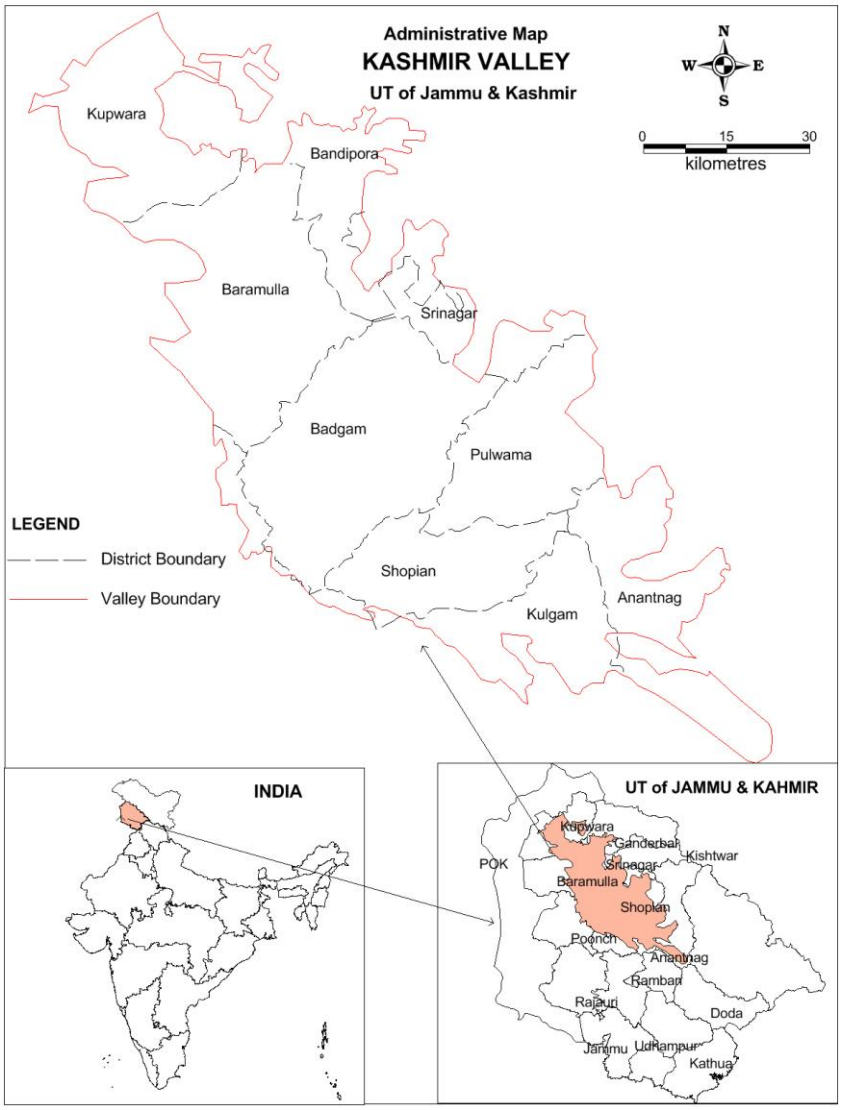


Fig -1: Administrative map of Kashmir valley

2.1 Geology & Hydrogeology

Kashmir valley covers an area of 5600 km. The main geological formation in the valley are Karewas & Paleozoic Sedimentaries and Volcanic. The Karewas are overlying the folded Zeewan formation & Panjal volcanics. Karewas consists of a huge pile of alternating bands of sand, silt and clay interspersed by glacial boulder beds. The sands are mostly fine to very fine. There is very rare chance that they are medium to coarse grained. Ground water in the Karewas of Kashmir valley occurs under both confined as well as unconfined conditions.

Hydro geologically, the valley is divided into two distinct and well-defined aquifer systems, viz., hard rock or fissured aquifer constituted mainly by semi-consolidated to consolidated rock units and soft sedimentary or porous aquifer constituted mainly by unconsolidated sediments.

3. Sampling, Methodology and Analysis

To assess the heavy metals concentration in the ground water of Kashmir valley, total 27 samples were collected from different National Hydrograph stations installed by Central Ground Water Board (Fig. 2). The samples were collected as per the procedure provided in APHA [13] and filtered through Whatman filter Paper and preserved with Nitric acid. The analysis of these preserved samples was carried out using Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) at Regional Chemical Laboratory, Central Ground Water Board, Northern Western Region, Chandigarh. This instrument works on the technique of induced coupled plasma to produce ions and then mass spectroscopy to detect the ions on the basis of charge and mass.

Fig -2: Groundwater Sampling Locations

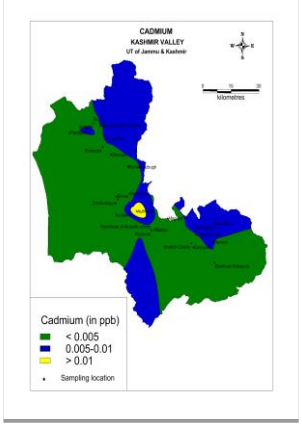
4. Results

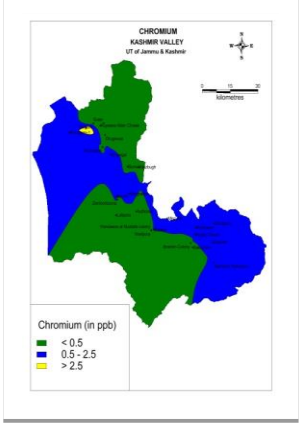
The concentration of heavy metals viz. Cadmium, Chromium, Copper, Manganese, Nickel, Lead, Zinc, Iron and Arsenic of the valley is reported in Table-1.

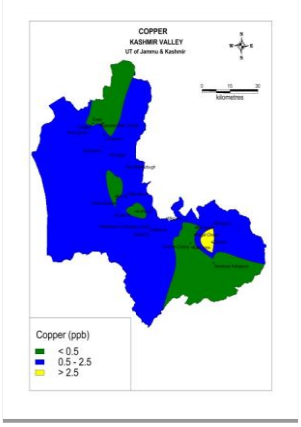
Table-1: Concentration of various heavy metals in water samples of Kashmir valley

S. No.	Location	District	Cd (ppb)	Cr (ppb)	Cu (ppb)	Mn (ppb)	Ni (ppb)	Pb (ppb)	Zn (ppb)	Fe (ppb)	As (ppb)
1.	Bomai	Baramulla	ND	0.42	0.74	2.06	0.72	ND	10.14	29.60	0.77
2.	Binner	Baramulla	ND	0.56	ND	9.61	0.34	ND	5.40	33.03	0.31
3.	Zambodzpora	Baramulla	ND	0.27	0.64	218.27	0.13	ND	9.71	31.93	0.70
4.	Mirgund	Baramulla	ND	0.96	0.84	0.99	0.44	ND	7.84	18.55	2.54
5.	Waripora	Baramulla	ND	0.36	1.24	0.89	0.79	ND	13.08	19.47	0.25
6.	Badran	Baramulla	ND	0.55	1.07	2.87	0.82	ND	12.35	13.21	0.75
7.	Handwara al Mustafa colony	Baramulla	ND	0.23	0.85	23.42	0.90	ND	7.91	43.06	0.44
8.	Ibrahim Colony	Baramulla	ND	0.23	0.33	2.99	0.55	ND	7.47	19.75	0.34
9.	Sangrama	Baramulla	ND	0.93	1.10	1.02	0.76	ND	10.93	40.75	1.02
10.	Regal Chowk	Budgam	ND	0.85	0.48	604.83	0.98	ND	8.33	27.32	2.16
11.	Said pora	Budgam	ND	0.30	0.19	5.17	0.48	ND	9.38	12.32	0.13

12.	Kupwara Main Chowk	Kupwara	ND	0.29	1.31	0.80	0.33	ND	5.15	15.12	1.61
13.	Drugmula	Kupwara	0.01	0.09	0.73	1.36	0.30	ND	28.07	16.44	0.54
14.	Guse	Kupwara	0.01	0.18	0.29	9.28	2.59	ND	17.17	22.54	0.38
15.	Gulgam	Kupwara	ND	0.05	0.13	12.28	0.62	ND	9.25	19.82	0.15
16.	Panzgam-1	Kupwara	ND	0.70	2.35	8.56	0.55	ND	7.14	13.09	0.26
17.	Trehgam	Kupwara	ND	4.65	0.32	1.58	0.79	ND	9.47	49.22	0.23
18.	Khanpora	Kupwara	ND	0.44	0.96	9.09	0.88	ND	10.38	27.01	0.68
19.	Dolipora	Kupwara	0.01	3.20	3.39	30.66	2.91	0.10	24.99	211.49	2.50
20.	Chowgal	Kupwara	ND	0.80	1.26	0.94	0.32	ND	15.23	22.73	0.60
21.	Sambura Kokapura	Pulwama	ND	0.54	0.09	0.48	0.13	ND	15.40	17.58	0.12
22.	Zeewan	Pulwama	0.01	1.51	5.40	3.49	0.57	0.51	291.82	213.25	0.28
23.	Mazbugh	Srinagar	ND	0.45	1.48	45.86	1.25	ND	12.97	40.51	0.63
24.	Authoora	Srinagar	0.01	0.18	0.28	1066.02	2.08	ND	103.73	252.44	0.45
25.	Lolipora	Srinagar	ND	0.32	0.74	6.36	0.47	ND	15.46	58.07	0.51
26.	Dusilpora	Srinagar	0.01	0.97	1.88	1.96	1.55	ND	19.86	45.70	0.80
27.	Rainawari	Srinagar	0.01	2.04	0.27	1.67	0.53	0.47	188.05	17.34	0.53







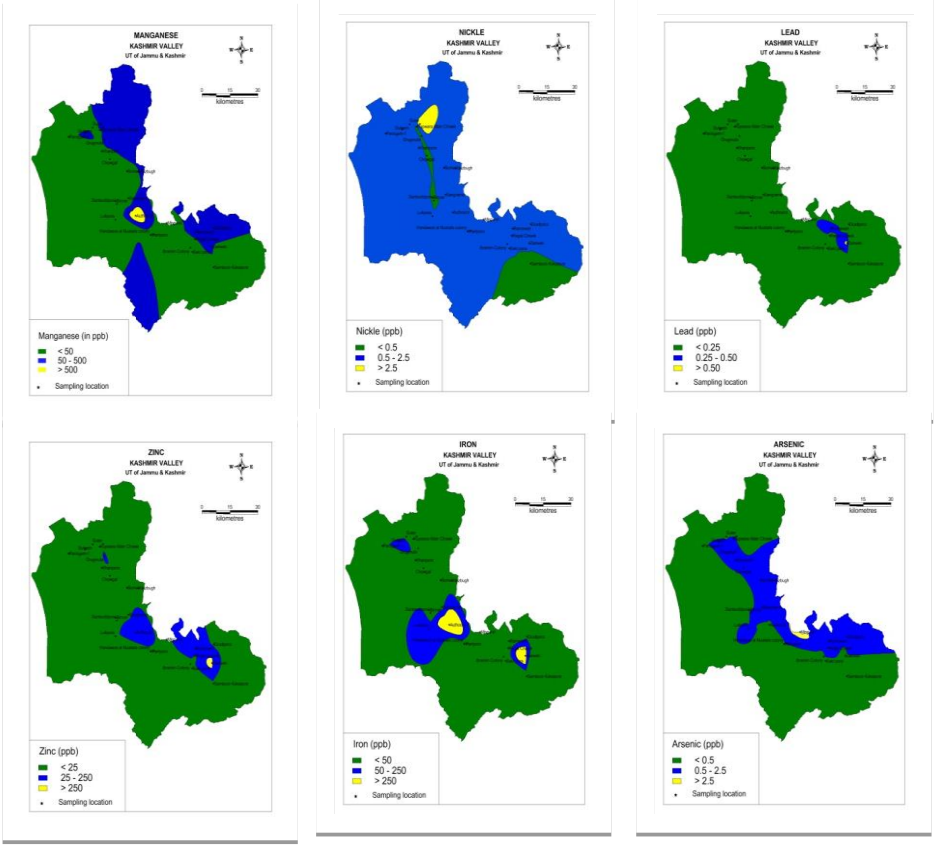


Fig -3: Spatial Distribution of Heavy metals in Kashmir Valley, UT of J&K

The district wise maximum, minimum and average concentration levels of heavy metals is reported in following tables

Srinagar District:

Concentration Levels	Cd (ppb)	Cr (ppb)	Cu (ppb)	Mn (ppb)	Ni (ppb)	Pb (ppb)	Zn (ppb)	Fe (ppb)	As (ppb)
Maximum	0.01	2.04	1.88	1066.02	2.08	0.47	188.05	252.44	0.80
Minimum	0.00	0.18	0.27	1.67	0.47	0.00	12.97	17.34	0.45
Average	0.01	0.88	0.97	312.79	1.21	0.13	77.30	97.69	0.60

Baramulla district:

Concentration Levels	Cd (ppb)	Cr (ppb)	Cu (ppb)	Mn (ppb)	Ni (ppb)	Pb (ppb)	Zn (ppb)	Fe (ppb)	As (ppb)
Maximum	0.00	0.96	1.24	218.27	0.90	0.00	13.08	43.06	2.54
Minimum	0.00	0.23	0.00	0.89	0.13	0.00	5.40	13.21	0.25
Average	0.00	0.50	0.76	29.12	0.61	0.00	9.43	27.71	0.79

Kupwara district:

Concentration Levels	Cd (ppb)	Cr (ppb)	Cu (ppb)	Mn (ppb)	Ni (ppb)	Pb (ppb)	Zn (ppb)	Fe (ppb)	As (ppb)
Maximum	0.01	4.65	3.39	30.66	2.91	0.10	28.07	211.49	2.50
Minimum	0.00	0.05	0.13	0.80	0.30	0.00	5.15	13.09	0.15
Average	0.00	1.37	1.30	9.64	1.14	0.02	14.55	56.55	0.87

Pulwama district:

Concentration Levels	Cd (ppb)	Cr (ppb)	Cu (ppb)	Mn (ppb)	Ni (ppb)	Pb (ppb)	Zn (ppb)	Fe (ppb)	As (ppb)
Maximum	0.01	1.51	5.40	3.49	0.57	0.51	291.82	213.25	0.28
Minimum	0.00	0.54	0.09	0.48	0.13	0.00	15.40	17.58	0.12
Average	0.00	1.03	2.75	1.98	0.35	0.26	153.61	115.41	0.20

Budgam district:

Concentration Levels	Cd (ppb)	Cr (ppb)	Cu (ppb)	Mn (ppb)	Ni (ppb)	Pb (ppb)	Zn (ppb)	Fe (ppb)	As (ppb)
Maximum	0.00	0.85	0.48	604.83	0.98	0.00	9.38	27.32	2.16
Minimum	0.00	0.30	0.19	5.17	0.48	0.00	8.33	12.32	0.13
Average	0.00	0.58	0.34	305.00	0.73	0.00	8.85	19.82	1.14

BIS 10500, 2012 limits of different Heavy metals in ppb:

BIS 10500, 2012	Cd (ppb)	Cr (ppb)	Cu (ppb)	Mn (ppb)	Ni (ppb)	Pb (ppb)	Zn (ppb)	Fe (ppb)	As (ppb)
Acceptable limit	3	50	50	100	20	10	5000	300	10
Permissible limit	3	50	1500	300	20	10	15000	300	50

It can be clearly observed from the data that the concentration levels of the heavy metals in the Kashmir valley is well within the range prescribed by the BIS [14]. Copper, Arsenic, Iron, Manganese, Zinc and Lead are geogenic and occurred in the earth crust thus they are dissolved in the groundwater through rock decompositions. These can also be deposited in groundwater through anthropogenic sources. On the other hand Cadmium, Chromium and Nickel are found through human activities such as mining, industrial use such as in electroplating, paints etc.

Pearson Correlation Coefficient:

Pearson Correlation Coefficient measures the correlation between the different parameters. Its value ranges from +1 to -1. + value indicates the positive correlation between the parameters, and – value indicates negative correlation between the parameters and 0 value indicate there is no relation between the parameters. Here we are showing the correlation of the all Heavy metals in the following table.

Heavy Metal	Cd (ppb)	Cr(ppb)	Cu (ppb)	Mn (ppb)	Ni (ppb)	Pb (ppb)	Zn (ppb)	Fe (ppb)	As (ppb)
Cd (ppb)	1.00	0.23	0.37	0.43	0.79	0.31	0.39	0.73	0.36
Cr(ppb)	0.23	1.00	0.27	-0.12	0.24	0.33	0.22	0.30	0.22

Cu (ppb)	0.37	0.27	1.00	-0.17	0.21	0.53	0.55	0.55	0.20
Mn (ppb)	0.43	-0.12	-0.17	1.00	0.32	-0.10	0.14	0.52	0.14
Ni (ppb)	0.79	0.24	0.21	0.32	1.00	-0.03	0.02	0.55	0.28
Pb (ppb)	0.31	0.33	0.53	-0.10	-0.03	1.00	0.94	0.38	-0.06
Zn (ppb)	0.39	0.22	0.55	0.14	0.02	0.94	1.00	0.56	-0.16
Fe (ppb)	0.73	0.30	0.55	0.52	0.55	0.38	0.56	1.00	0.15
As (ppb)	0.36	0.22	0.20	0.14	0.28	-0.06	0.15	0.15	1.00

5. CONCLUSION

In general the water quality has been found potable in the Kashmir valley. There is no such contamination and pollution through heavy metals in ground water. Ground water development in Kashmir is in the early stages; therefore ground water management is necessary to keep it free from any contamination.

ACKNOWLEDGEMENT

The authors are grateful to the Chairman, CGWB and Member (N&W), CGWB for their esteem guidance and support throughout the studies. The authors are also grateful to Regional Director, CGWB, NWR, Chandigarh for his kind support. We are also grateful to Sh. Dhan Prakash, Sh. Rishi Raj and Sh. Kiran Lale for giving valuable time and helping in the analysis of Heavy metals samples trough ICP-MS present in the Chemical Laboratory of Central Ground Water Board, Chandigarh.

REFERENCES

[1] *Rodell M, Veliconga I, Famiglietti J.S., Satellite- Based Estimates of Ground Water Depletion in India. Nature 2009, 460, 999-1002*
[2] *Central Ground Water board, Dynamic Ground Water Resources of India, 2017.*
[3] *Bhuyan B, A study on Arsenic and Iron Contamination of Groundwater in Three Development Blocks of Lakhimpur District, Assam, India, Report and Opinion, 2010;2 (6)*
[4] *Handa, B.K. Geochemistry and Genesis of Fluoride-Containing Ground Waters in India. Groundwater 1975, 13, 275-281.*
[5] *Agarwal, G.D., Lunkad, S.K., Malkhed, T. Diffuse Agricultural Nitrate pollution of groundwaters in India. Water Sci. Technol. 1999, 39, 67-75*
[6] *Kurito, P., Harmonien, A. Saha, H, Salonen, L., Karpas, Z., Komulainen, H. and Auvinen, A Kidney toxicity of ingested uranium from drinking water. American journal of kidney diseases, 47 (6), 972-982.2006.*
[7] *National Water mission Vulnerable and over exploited areas http://nwm.gov.in/?q=vulnerable-over-exploited-areas*
[8] *Gulzar A, Mehmood M.A., Bhat R.A., Ganie. S.A. Assessment of ground water quality in anantnag district of Kashmir valley (J&K) Trade.AJST, Vool.08, Issue 09, pp-5803.-5811*
[9] *He ZL, Yang XE, Stoffella PJ. Trace elements in agroecosystems and impacts on the environment. J Trace Elem Med Biol. 2005;19 (2–3):125–140.*
[10] *Shallari S, Schwartz C, Hasko A, Morel JL. Heavy metals in soils and plants of serpentine and industrial sites of Albania. Sci Total Environ. 1998;19209:133–142*
[11] *World Health Organization. Switzerland: Geneva; 1996. Trace Elements in Human Nutrition and Health.*
[12] *Ground Water year Book, Jammu & Kashmir, 2017, CGWB, NWHR, Jammu.*
[13] *APHA, Standard methods for the examination of water and wastewater. Washington, DC: American Public Health Association.*
[14] *BIS 10500:2012 Indian Standard Drinking Water- Specification (Second Revision)*