Negative Impact of Audit and Mining Water at Holodninsky Mine on Surrounding Water Sites

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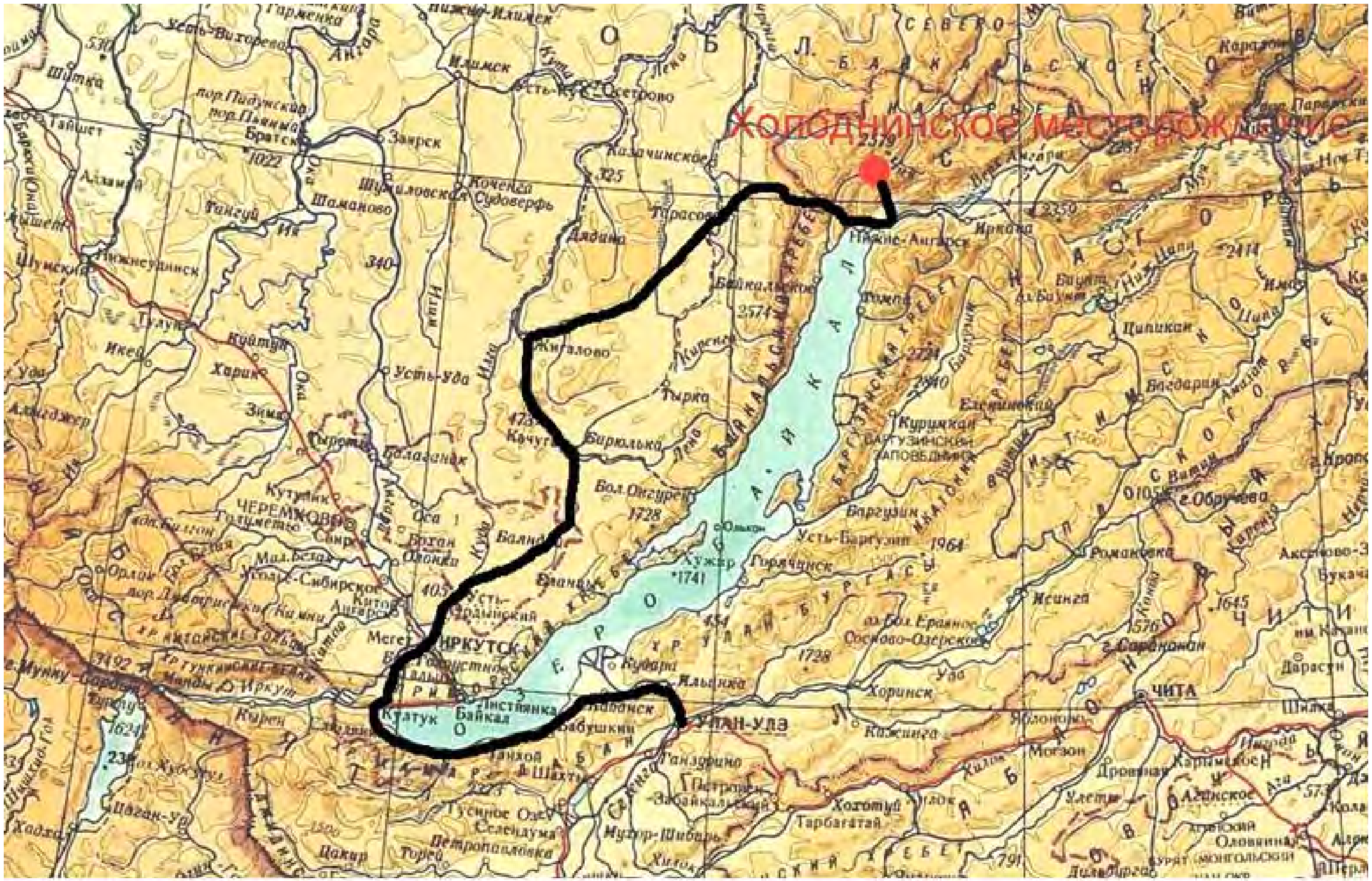
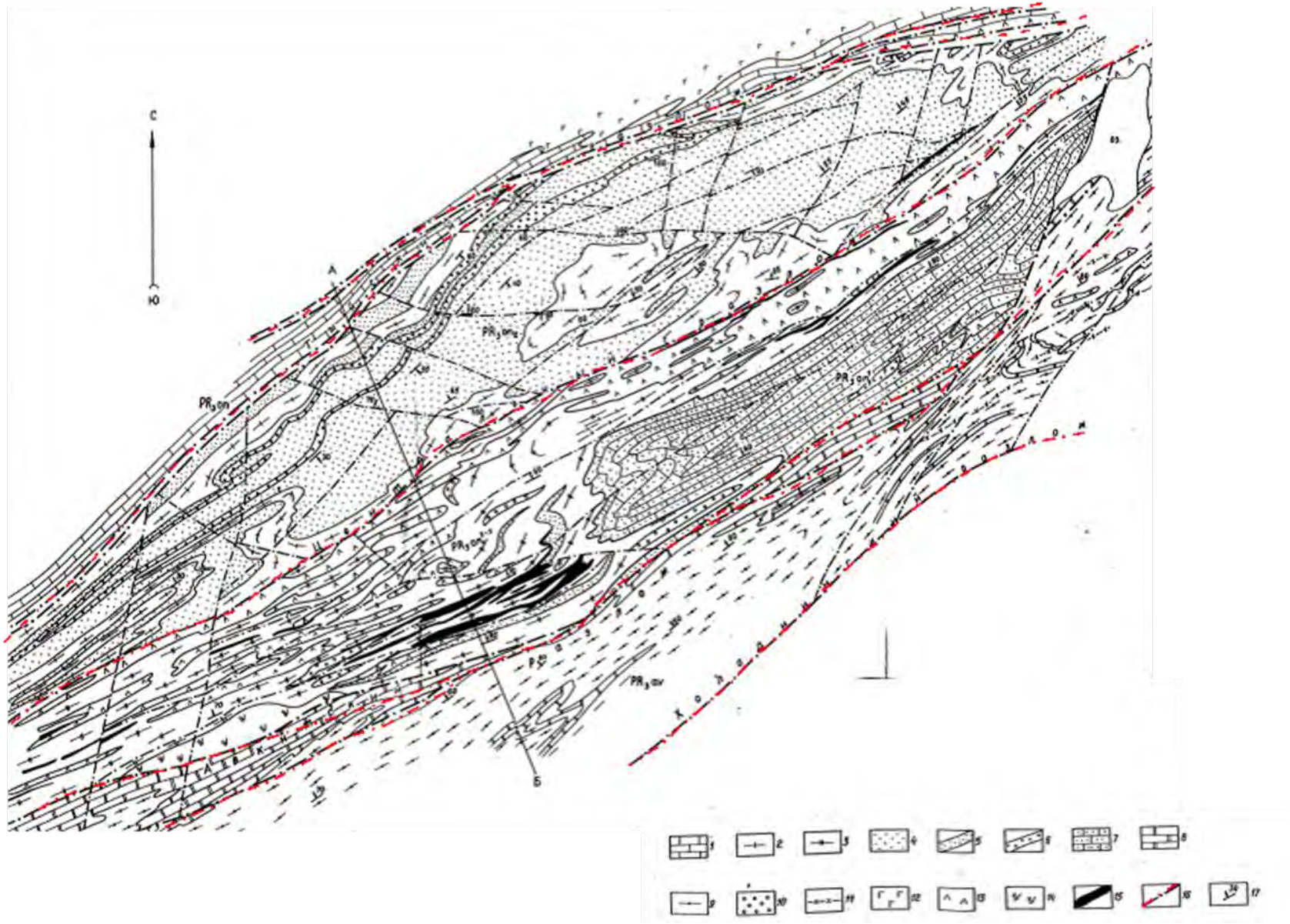
Holodninski site is 70 km from the northern point of Lake Baikal, which is still its water collecting area (black line shows the route from Ulan-Ude to the site by car).



Deposit is situated in the southern part of Nothern-Baikal highland, which is a part of watershed of rivers Tii and Holodnaja. A part of the deposit is in the valley of the river Holodnaja. The site region is charachterized by intense diversity of relief, with picks above valleys as high as 300 to 500 m. The area where detailed geological survey was conducted is situated in the limits of absolute markers 1000-1100 m.

Panarama of the valley of the river Holodnaja

Geological Structure of Holodninski deposit (Distanov et. al., 1982)



Composition of microelements of water in the river Holodnaja in the region of Holodninsky pollymetalic mine

№ п/п	Химический элемент, мкг/л	ХВ – 6 56°12,893’, 109°52,046’ 400 м выше по течению от места расположения отвалов штольни	ХВ – 4 56°12,893’, 109°52,046’ 10 м ниже впадения ручья из штольни	ХВ – 8 56°06,040’, 109°43,815’ 3 км ниже по течению от впадения ручья из штольни
1	Cr	0.21	0.10	0.24
2	Mn	20.78	17.43	6.16
3	Fe	21.13	3.98	20.64
4	Co	0.15	0.08	0.05
5	Ni	3.68	0.69	0.86
6	Cu	4.81	1.84	4.32
7	Zn	1458.34	368.45	103.47
8	As	1.19	5.48	1.16
9	Cd	0.29	0.11	0.11
10	Ta	0.0010	0.0006	0.0009
11	Pb	0.29	0.33	0.25

Composition of microelements of water in the stream Avkitsky

№ п/п	Химический элемент, мкг/л	ХВ – 7 56°13,275', 109°50,609'	ХВ – 3 56°13,075', 109°52,056'
		Верховье ручья, у моста возле дороги к п. Перевал	Нижняя часть ручья, в 50 м выше устья, находиться в зоне влияния отвалов пород
1	Cr	0.25	0.2589
2	Mn	4.0405	12.2713
3	Fe	46.0248	14.9031
4	Co	0.0715	0.1710
5	Ni	1.1920	2.0947
6	Cu	2.1856	11.5946
7	Zn	70.1749	354.4906
8	As	0.2809	3.0485
9	Cd	0.0942	0.1732
10	Ta	0.0013	0.00001
11	Pb	0.2848	0.1247

The area of study is located at the steep slope of the valley of the river Holodnaja, where the two adits are situated. The first audit is at 940 м, the second– at 850 м. As the result of constructing an audit, there was 90000 $м^3$ of rock excavated to the surface and piled at two locations.

Audit №1

The entry into the second audit is 40 м high and100м wide. The area in front of the audit is 50x100 м and is partially covered with rock waste from audit.

Adit №2

Rock waste and mine water at Audit №2

Rock waste is enriched by miniralisation. These minerals appear as white, yellow and brown deposits over the entire area. Chemical analysis as well as structural analysis show the presence of certain elements: magnesium, zink, starhit, etc.

Mining water surfaces from the audits, which in turn run into the river Holodnaja. A portion of water from the audits runs as ground water

Mining water from Audit №1

Mining water from Audit №2

Characteristics of mine water from the adits

№ пр.	Место отбора пробы, координаты	Породы	Дебит	Температура	pH	Сухой остаток, мг/дм^3
191	Рудничные воды из штольни №1 N 56°13.483' E 109°52.196'	Метаморфические сланцы, кварциты, карбонаты	опробование 21.04.2007			
			0,3 л/сек	2,1°C	7,2	821,21
w-1			опробование 12.09.2007			
			5 л/сек	0,8 °C	7.1	
хв-1			опробование 19.09.2013			
			1,3 л/сек	3,9 °C	7,24	736,0
192	Рудничные воды из штольни №2 N 56°13.352' E 109°52.527'	Метаморфические сланцы, известняки	опробование 21.04.2007			
			50 л/сек	4,1°C	7,1	477,99
w-2			опробование 12.09.2007			
			110 л/сек	1,9 °C	7.07	
хв-2			опробование 19.09.2013			
			30 л/сек	5,6 °C	7,15	485,0

Concentration of toxic elements in mining water, running from the audits at Holodninsky mine (мкг/ дм^3) (19.09.2013 г)

Defining parameter	Stream from Audit №1	Stream from Audit №2	Stream of Audit №2,	ПДК in the streams running into the Lake Baikal in the central area	ПДК water in sites for the fishing industry.
Дебит, л/сек	1,3	30,0	7,0		
Li	4,91	2,24	2,24		
Sr	501,44	626,37	601,25		
Cr	0,094	0,067	0,058	8	90
Mn	969,79	494,07	835,31		10
Fe	420,06	12,36	4,07	200	100
Co	18,39	4,02	3,81		10
Ni	29,39	9,52	10,90	8	10
Cu	1,44	5,41	2,25	8	1
Zn	21104,09	5491,05	6994,42		10
As	0,227	1,597	1,359		
Cd	9,15	0,81	1,90		0,5
Ta	0,001	0,0003	0,0005		
Pb	0,238	0,105	0,161		10

Chemical composition of deposits at the bottom of the streams, running from the audits, %.

Компонент	Донные отложения в ручье, вытекающем из щтольни №1, хд-1	Донные отложения в ручье, вытекающем из щтольни №2, хд-2	Донные отложения в устье ручья из штольни №2, хд-5в
SiO2	31,16	12,55	12,98
TiO2	0,413	0,105	0,144
Al2O3	9,1	1,68	3,1
Fe2O3 общ.	26,92	34,72	23,9
MnO	0,409	3,974	1,126
MgO	2,04	1,142	0,797
CaO	1,708	2,637	2,135
Na2O	1,15	2,07	4,26
K2O	1,314	0,336	0,269
P2O5	0,123	0,046	0,088
п.п.п	20,29	22,43	27,81
сумма	94,627	81,69	76,609
V	0,0085	0,0028	0,0034
Cr	0,0079	0,0030	0,0036
Ni	0,0023	0,0044	0,0041
Cu	0,0091	0,0091	0,0050
Zn	2,13	7,77	19,15
As	0,0050	0,0238	0,0108
Pb	0,2182	0,0877	0,0282
Ba	0,0870	0,230	0,0869
Cd	0,0040	0,0053	0,0075
SO3	2,95	0,7	0,4
Cl	0,2	0,1	0,1
Hg (мг/кг)	0,866	0,524	0,096

In laboratory conditions, we studied the sorption ability of limestone, which is located near the mine.

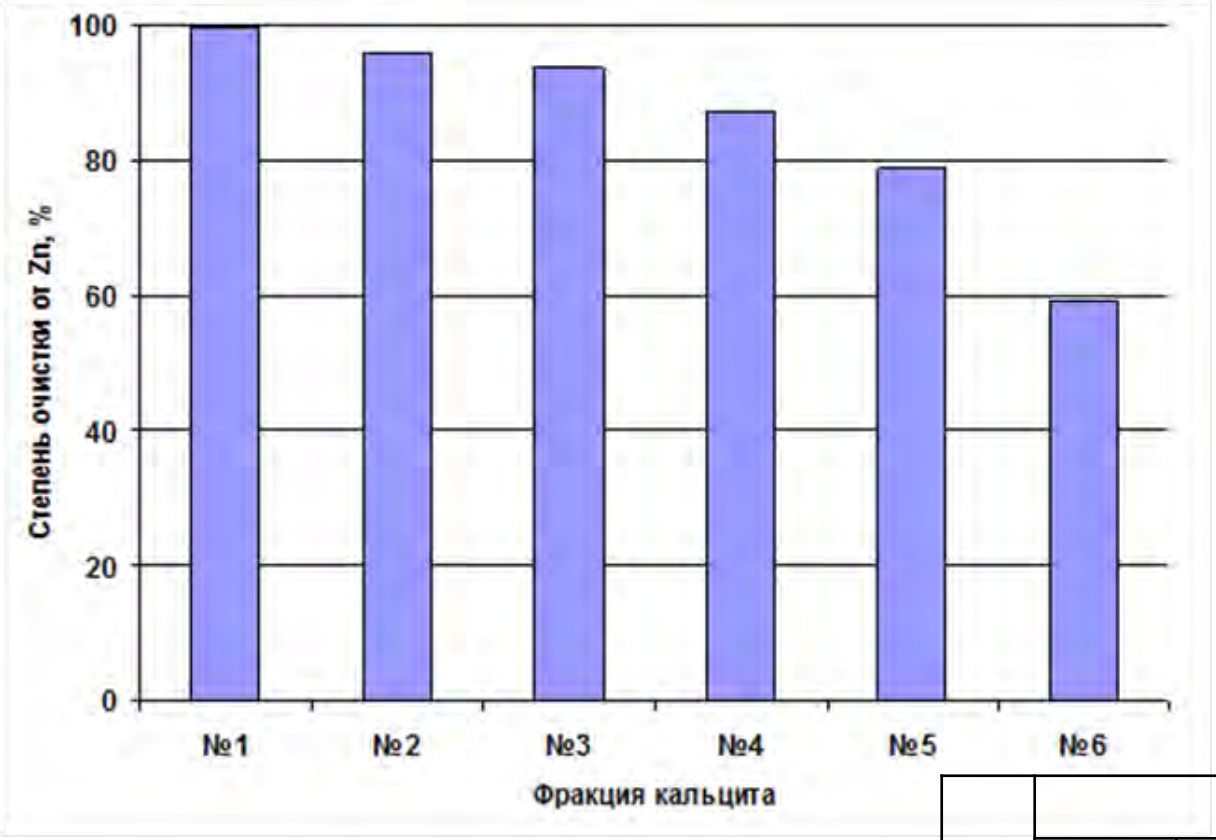
Experiments were conducted in static as well as dynamic conditions

We studied the sorption ability of various kinds of limestone in relation to the heavy metals.

The rate of treatment of mine water in static and dynamic conditions is determined.

Some of the results are presented below

Results of experiment of sorption of zink by calcite(50 г/л) in static conditions during 6 hours

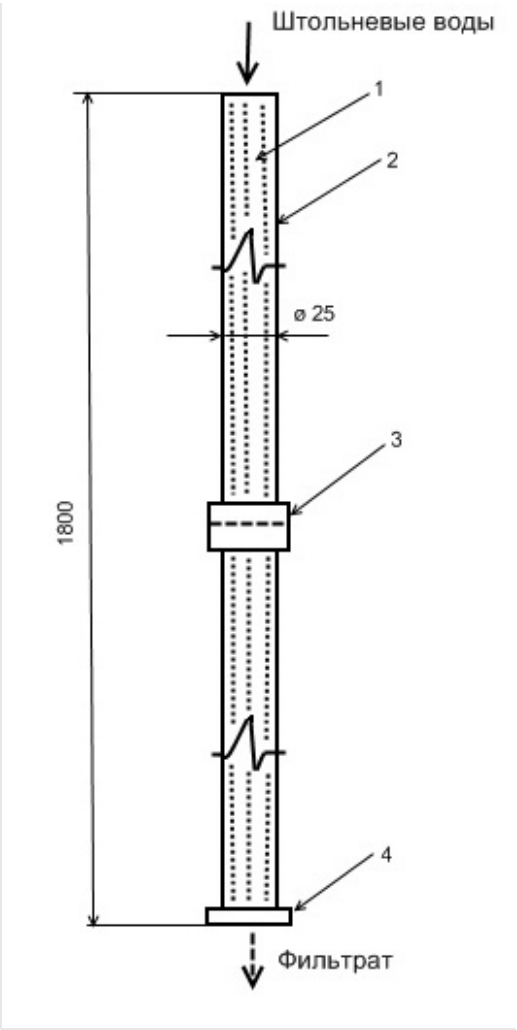


	Фракция, мм					
	–0.25	–0.25 +0.50	–0.5 +2.0	–2.0 +3.0	–3.0 +5.0	–7.0 +10.0
	№ 1	№ 2	№ 3	№ 4	№ 5	№ 6

Treatment rate of ions of manganese during 6 hour contact

Образцы	1 г/л		10 г/л		20 г/л		50 г/л	
	мг/л*	степень очистки %	мг/л*	степень очистки %	мг/л*	степень очистки %	мг/л*	степень очистки %
№ 1	0.2093	42.92	0.0107	97.08	0.0010	99.73	0.002	99.40
№ 2	0.3065	16.41	0.2432	33.68	0.1790	51.18	0.1294	64.71
№ 3	0.3130	14.64	0.2846	22.39	0.2537	30.81	0.1430	61.00
№ 4	0.3119	14.94	0.2884	21.35	0.2505	31.69	0.1990	45.73
№ 5	0.3185	13.14	0.2839	22.58	0.2667	27.27	0.2048	44.15
№ 6	0.3171	13.52	0.2697	26.45	0.2909	20.67	0.2465	32.78

Schema of experimental structure and results of treatment of mine water from some metals in dynamic conditions (mass of sorbent 800 g, mine water 1000 ml)



элемент	штольневая вода, мг/л	Динамический режим	
		мг/л	степень очистки
Zn	3.19800	0.0031	99.90
Mn	0.36670	0.00060	99.83
Fe	1.03850	0.00125	99.88
Pb	0.00410	0.00155	62.19
Cu	0.01130	0.0023	79.65
Cd	0.00300	0.0004	86.66

Conclusions, Recommendations

There are two ways to isolate liquid conteminants , which resulted from the work at Holodninsky, from the environment– change them into insoluble elements at the site or close the access to the audit and cut them off from getting to the surface.

Premises:

1. It's been determined that limestone известняк absorbs ions of heavy metals from mining water
2. It is possible to create a geochemical barrier at Holodninsky near drainage of mining water from adits according to the stages of treatment all the way to the point of quality of use in the fishing industry.

3. Isolate adit water from mining, by using concrete blocks and filling empty spaces with rock material from adit. Install concrete blocks beyond the line of multi-year-iced material and within the limits of crystallized dry material at a distance of 70-100 м from adit.

4. Reclamation of rocky areas should be done at their location; create compact deposits at the slopes. Next, cover them with iced substance and then with peat in order to keep the waste in iced condition.

Спасибо за внимание!