

ORDINSKAYA CAVE - THE LONGEST UNDERWATER CAVE IN RUSSIA

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Abstract: Ice forms always attracted attention of scientists in Perm region. They were mentioned for first time as ago as in 1722 by V.I. Gennin who wrote about ice in Kungur Ice cave. Very big attention to ice from this cave paid also G.A. Maximovitch. He has described origin of ice, has classified it, studied ice chemistry and wrote the first instruction about cave's ice studying. He has divided cave's ice origin on hydrogeneous, atmogeneous and heterogeneous, hi modern classifications are subtracted konjelation, sublimation and sedimentary metamorphic origins of cave's ice.

Authors are studied the ice formations of longest underwater gypsum cave of the world - Orda cave. Length of it dry part is 400 m and underwater one - 4000 m the cave is situated in 100 km to south-east from Perm. There are ice formations - stalagmites, stalactites and ice covers inside the cave.

The bed-rock in the cave's area consists from sedimentary of Iren and Philippovka horizon of Kungur stage. Under Olkha breccia there is destroyed from surface gypsum and anhydrite of Shalashnino geological formation underlayered by carbonate rock of Nevolino geological formation and under it - gypsum and anhydrite of Ledyanopechsherskaya geological formation. Ledyanopechsherskaya geological formation is underlayered by dolomite and limestone of Philippovka horizon. Breccias consists from clay, loam, rock debris and pieces of destroyed carbonate and sulphate rock.

In 2004 have been sampled the stalagmites in Ice chamber room. Ice's chemistry of melt stalagmite is close to chemistry of surface and underground water of area in suburbs of the cave. Water has high content of calcium (0,5 g/l) and sulphate-ion (1,2-1,3 g/l) and mineralization approximately 2 g/l.

There were studied the mineral inclusions of ice stalagmite. X-ray analyze of samples made by V. Shlykov has shown the next: gypsum (45,3%), calcite (5,2%), quartz (2,2%), dolomite (1,0 %) and anhydrite (0,3%). So, inclusions are the mixture of fragments of rock from ceiling and ones brought by penetrating water.

Key words: ice, cave, chemistry, mineralogy, stalagmites.



Entrance in Ordinskaya Cave. June, 2004.

Foto by A. Denisov

Perm Region is the easternmost European Region of Russia, situated near the Ural Mountains, which, in turn, form the border between Europe and Asia. As a matter of interest, the Permian period of geological history is named after the Russian city of Perm, the center of Perm Region.

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There are about 10 000 caves in Russia, more than 700 of which are in Perm Region. This region is world famous for its Kungur Ice Cave - the oldest tourist cave in Russia. Another cave of the Perm Region has recently become famous: Ordinskaya Cave.

Ordinskaya Cave is one of the major discoveries in Russian speleology. It is currently the longest underwater system in Russia (and in the former USSR). As of June

2007, a total length of 4000 metres of underwater passages has been surveyed in this unique cave. The underwater passages in this cave also contain the largest syphon (underground passage completely flooded with water) in Russia and the former territory of the USSR, with a length of 935 metres. The current total length of the cave, including dry sections and lakes, is currently 4400 metres with a vertical range of 43 metres.

Ordinskaya is located 1 km. southwest of the village of Orda, in the Ordinskiy District of Perm Region (100 km. southeast of Perm). Situated at an altitude of 160 metres a.s.l., the cave lies on the steep left bank of the Kungur River Valley adjacent to Kazakovskaya Mountain. The entrance is approximately five metres wide and two metres high, at the base of a karst sinkhole 15 metres in diameter and some 10 metres in depth.

Ordinskaya Cave is located at the eastern edge of the Russian Plain. Kazakovskaya Mountain massif, in which the cave is situated, presents a plateau-like upland. From the south, east and north it is embraced by the Kungur River valley. The karst massif rises some 50 metres above the river giving a limited area for cave development. Two different strata take part in the geological structure of Kazakovskaya Mountain: the «covering», consisting of karst-collapse sediments, and «bedrocks» of the Kungurian Stage of the Early Permian. There are large karst sinkholes on the surface of the mountain, in one of which, located on the southern steep slope of the massif, the cave entrance is situated.



Ice formations in Ordinskaya Cave. Foto by I. Lavrov

From the entrance, a talus of block-collapse and clay sediments extends down into

the cave and continuing to «Crystal Hall» with a length of 30 metres, width of 15 metres and height of up to 8 metres. In the arch of the hall, gypsums and anhydrites are exposed, and lower down - the limestones and dolomites. In the northwest corner of the hall, at a depth of 21 metres from entrance, the «Ice Lake» is situated with its water level close to that of the Kungur River. The main passage of the cave turns to the left from the entrance hall and comes to the 50 metre long «Ice Palace Hall» which extends in a southwest direction, with dimensions of up to 15 metres in width and up to 7 metres height. In the right wall of the hall, limestones and dolomites are exposed, and in the ceiling - gypsum is exposed. The floor of the hall is covered with debris which fell from its ceiling. The amount of collapse-debris increases upon moving away from the entrance, the floor raises and at the end of the hall it is almost closed up with the ceiling. In the northeast part of the hall there is the «Main Lake» with an area of about 20 square metres. At the end of the hall there are two passages in a block bulk which lead firstly to the distant «Warm Lake» with an area of 25 square metres and then to the last hall of the dry part of the cave - Maximovich's Hall».

Cave lakes are the entrances to the big underwater system of passages which was formed in the Ledyanopescherskaya Layers of gypsums and anhydrites of the Irenskiy Horizon of Kungurian Stage of Early Permian. The total area of Ordinskaya Cave is over 50000 square metres.

In 2004 stalagmites were selected in the Ice Palace grotto. The chemical composition of the melted ice is shown in table 1. It is similar to the composition of the surface and underground waters of the cave region (table 2, 3), which have high content of calcium (0,5 g/l) and sulfat-ion (1,2-1,3 g/l), mineralization is near 2 g/l.

Mineral impurities were researched in the ice stalagmite. X-ray analysis which was made by V.G. Shlikov, showed the following composition: gypsum (45,3 %), calcium (5,2 %), quartz (2,2 %), dolomite (1,0 %), anhydrite (0,3 %). According to the composition, impurities are the mixture of fragments of the rocks fallen down from the cave's domes and particles brought by the seeping waters.

Table 1. The chemical composition of stalagmite's ice in Ordinskaya Cave

The date of selection	Content in mg/l													
	HCO ₃ ⁻	SO ₄ ²⁻	Cl ⁻	NO ₃ ⁻	NO ₂ ⁻	CO ₃ ²⁻	Ca ²⁺	Mg ²⁺	Na ⁺ +K ⁺	NH ₄ ⁻	Fe ²⁺	Fe ³⁺	Mineralization	pH
24.06.04	36,61	1412,59	8,51	0,80	0,11	0,00	591,18	0,00	15,17	1,84	0,00	0,00	2066,81	7,72
10.07.04	36,61	1153,70	7,09	0,00	0,11	0,00	495,99	0,00	0,46	0,90	0,00	0,06	1694,02	7,02

Table 2. The chemical composition of water in Kungur River (24.06.2004)

The place of selection	Content in mg/l													
	HCO ₃ ⁻	SO ₄ ²⁻	Cl ⁻	NO ₃ ⁻	NO ₂ ⁻	Ca ²⁺	Mg ²⁺	Na ⁺ +K ⁺	NH ₄ ⁻	Fe ²⁺	Fe ³⁺	Mineralization	pH	
the dam over the cave	122,03	1271,38	11,34	1,20	0,08	521,04	30,38	6,44	0,54	0,00	0,05	1964,48	7,77	
over the cave	183,05	1318,45	9,93	3,80	0,07	513,06	42,53	18,16	0,00	0,00	0,04	2107,09	7,10	
under the enter	122,03	1318,45	11,34	3,05	0,06	531,06	36,41	7,36	0,00	0,00	0,00	2029,85	7,77	
the creek beneath the cave	158,64	1271,38	11,34	2,70	0,08	541,08	24,31	9,20	0,58	0,00	0,05	2019,36	7,78	
the Kungur River	158,64	1294,91	9,93	2,05	0,07	526,05	33,42	19,77	0,00	0,00	0,09	2044,93	7,90	

the Kungur River, the lower bridge	213,56	918,35	11,34	6,15	0,07	390,78	26,73	23,91	0,00	0,00	0,08	1590,97	7,95
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Table 3. The chemical composition of lakes in Ordinskaya Cave (24.06.2004)

Content in mg/l

The date of selection	HCO ₃ ⁻	SO ₄ ²⁻	Cl ⁻	NO ₃ ⁻	NO ₂ ⁻	Ca ²⁺	Mg ²⁺	Na ⁺ +K ⁺	NH ₄ ⁻	Fe ²⁺	Fe ³⁺	Mineralization	pH
the Main Lake	97,63	1365,52	9,93	6,70	0,03	551,10	24,31	21,15	0,00	0,00	0,02	2076,39	7,01
the Ice Lake	97,63	1341,98	7,09	5,70	0,05	551,10	24,31	7,59	0,00	0,00	0,02	2035,47	7,30

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