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3rd International Workshop on Ice Caves International Workshop on Ice Caves

International Workshop on Ice Caves

Polar Grotto
Kungur Ice Cave
Photo: Aleksey Mokrushin

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Mining Institute
Perm State University

3-rd INTERNATIONAL WORKSHOP ON ICE CAVES - KUNGUR ICE CAVE, RUSSIA - MAY 12-17, 2008

IWIC-III

МИНИСТЕРСТВО
ПРИРОДНЫХ РЕСУРСОВ
ПЕРМСКОГО КРАЯ

ГОРНЫЙ ИНСТИТУТ
УРАЛЬСКОГО ОТДЕЛЕНИЯ
РОССИЙСКОЙ АКАДЕМИИ НАУК

VOLUME OF ABSTRACTS

3-rd International Workshop on Ice Caves

3-й Международный Симпозиум по пещерам с ледяными образованиями

UIS - GLACKIPR
Glacial Caves and Cryokarst in Polar And High Mountain Regions Commission

UNIVERSITA' DEGLI STUDI DI MILANO
Dipartimento di Scienze della Terra "Ardito Desio"

DISAT
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Dipartimento di Scienze dell'Ambiente e del Territorio

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IWIC-III
3rd INTERNATIONAL WORKSHOP ON ICE CAVES

Kungur Ice Cave, Perm Region, Russia
May 12 –17, 2008

VOLUME OF ABSTRACTS

Edited by
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Mining institute of Ural branch of RAS
Perm State University
Karst and Speleology research Institute
Institute of Geography of RAS
UNIVERSITA' DEGLI STUDI DI MILANO - BICOCCA *Dipartimento di Scienze dell'Ambiente e del Territorio*
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IWIC-III is organized under the auspices of UIS-GLACKIPR, the Glacial Caves and Cryokarst in Polar and High Mountain Regions Commission of the International Union of Speleology.

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FOREWORD

Dear Colleagues,

as decided in 2006 during IWIC-II in Slovakia, we are glad to host you at the third edition of International Workshop on Ice Caves in Russia.
IWIC-III will focus on anthropogenic influence on ice caves, changing of microclimate of such caves, saving and protection of ice caves.
The programme of IWIC-III contains the contributions oral and poster presentation sessions and also some field excursions: to the Kungur Ice Cave - one of the oldest show caves with perennial ice in the world, and we organized excursions to some caves with ice deposits in Perm region and salt mines, which are situated at North of our region.
We hope the IWIC-III will be successfull and important event for activities of scientific comunity interested in wide-ranging topics of ice caves.

We wish you a pleasant stay in Russia
Sincerely yours,

Dr. Olga Kadebskaya
Prof. Viktor Dublyanskiy
Prof. Valeriy Kataev
Dr. Bulat Mavlyudov
Prof. Valter Maggi

ORAL PRESENTATIONS

INFERENCES FROM 2-YEARS ISOTOPE HYDROLOGICAL MONITORING IN BORŢIG ICE CAVE, ROMANIA

Fórizs I.[1], Kern Z.[1], Perşoiu A.[2], Nagy B.[3], László P.[3]

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Borţig Ice Cave (46.56 N 22.69 E; 1236 m asl.) is the third largest ice cave of Romania. The cave contains 25 000 m^3 of stratified ice. Its maximum thickness is approx. 23 m. Water entering into the cave have been collected at two places: precipitation fallen through the cave opening and dripping water. Stable isotopic compositions of precipitation and dripping water are close to the Global Meteoric Water Line (GMWL). The isotopic composition of precipitation follows the well-known annual cycle and shows larger variability than dripping water.

The stable isotopic compositions vary δD from -200.4‰ to -35.1‰, and $\delta^{18}O$ from -25.69‰ to -4.14‰ for precipitation; while for dripping water they vary δD from -155.4‰ to -59.6‰, and $\delta^{18}O$ from -20.92‰ to -9.69‰ during the studied period (17 September, 2005 -11 March 2007).

To assess the δ-T relationship we calculated the mean surface air temperature of sampling periods from hourly data recorded approximately 2 kms away from the Borţig Ice Cave. Comparison revealed a quite good linear relationship.

DECIPHERING MULTIDECADAL CLIMATE SIGNAL FROM A CAVE ICE CORE, BORŢIG ICE CAVE, ROMANIA

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Borţig Ice Cave (46.56 N 22.69 E; 1236 m asl.) is the third largest ice cave in Romania. The cave contains 25 000 m^3 of stratified ice. Its maximum thickness is approx. 23 m.

In order to estimate the ice accumulation rate and the stable isotopic feature of the cave ice two 2 meters long drill cores were extracted from the floor ice on 11-12 December, 2005. $^{18}O/^{16}O$ and D/H ratios were determined by continuous-flow mass spectrometry and tritium content was analysed by liquid scintillation technique from the meltwater. We have neglected the two upper samples from further investigation due to their inhomogeneous character.

The stable isotopic composition of samples varied from -91.2‰ to -68.6‰ and from -12.44‰ to -9.7‰ for δ D and $\delta^{18}O$, respectively.

We have calculated a theoretical curve of tritium content of atmospheric precipitation at the Borţig Ice Cave by interpolation from the measured record of nearest GNIP stations (Budapest, Beograd, Odessa and Vienna). Tritium curve of cave ice core showed a very similar pattern compared to the calculated curve. The most prominent peaks of the cave ice record were tuned to the (assumed) corresponding peaks of the calculated curve and age-depth model was developed. The depth scale was converted to age scale by the derived model and stable isotopic fluctuation was compared to normalised temperature record of two neighbouring meteo-stations (Baisoara, Debrecen). Visual comparison suggests high similarity between the fluctuation of stable isotopic record of the cave ice and the regional annual mean surface temperature. Increase in $\delta^{18}O$ values is accompanied with temperature increase.

2000 YEARS OF HISTORY IN FOCUL VIU ICE CAVE, ROMANIA

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The 8.26 m of ice core drilled in Focul Viu Ice Cave (Apuseni Mountains, Romania) represent one of the longest ice record from hipogean ice deposits. Sets of 8 radiocarbon dates were done on organic materials found in the ice cores at different depth. That permit to estimate the age at 6.84 m depth of 1790±30 year B.P. (radiocarbon date). However the time/depth curve, show a strong increase in accumulation rate during the Middle Age period, probably related to a real increase of snowfall during the period. The record of no-sea salt (nss) sulphates denote some large spikes between 2.02 m and 7.13 m depth, primarily dated from 290±30 to 1790±30 Years B.P. (radiocarbon dates), probably related to volcanic events, and an increase at high levels in the upper 80 cm, related to the increase of sulphate emission during the industrial era. A tentative of recognition of single volcanic events were done for improve the timescale. In this way also the upper sulphate increase can help the timescale. In-fact comparing the Focul Viu record with the sulphate record from Colle Gnifetti (Italian Alps) can be estimate the 80 cm depth around 1800 a.C.

PRELIMINARY RESULTS OF ICE TEMPERATURE MEASUREMENTS IN THE DOBŠINSKÁ ICE CAVE (SLOVAKIA) AND SCĂRIŞOARA ICE CAVE (ROMANIA)

Strug K.[1], Perşoiu A.[2,3], Zelinka J.[4]

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In the past years, a series of studies have shown that perennial ice accumulations in caves might record important informations regarding past climatic changes. However, in order to decipher the climatic signals recorded in the cave ice, a good understanding of the processes that act is necessary. Occasional observations have shown that cave ice is close to the melting point, so that the chemical and physical properties of ice might be influenced by changes in ice temperature. In order to decipher the mechanism of heat transfer in ice, a program of ice temperature monitoring was initiated in the summer of 2007 in two caves, Dobšinská Ice Cave (Slovakia) and Scărişoara Ice Cave (Romania). Ice temperature is being measured once a week along both vertical and horizontal profiles in both caves (with probes installed at 0,25; 0,5; 1.5 and 6,7 m bellow surface), while air temperature is continuously monitored both inside and outside the caves. Parallel to temperature monitoring, observations of ice dynamics is being carried out. In this paper, we report the preliminary results, after 10 months of monitoring. The data shows that there is a good correlation between the air and ice temperature, especially near the surface, while with increased depth, the amplitude of ice temperature is slowly decreasing. Immediately after the installation of the probes, the changes in ice temperature were rapid and chaotic, as the borehole was filled with water. Shortly after the air temperature went bellow 0°C in the caves, the temperature of ice dropped and remained bellow freezing point, with higher variations near the surface and reduced ones at depth. Changes in temperature along both horizontal and vertical profiles shown a similar pattern, so that we could appreciate that ice stratigraphy is not important in the transmission of heat waves inside the ice. Comparison of ice temperatures in the two caves show that the values are nearly similar, being slightly lower in Dobšinská Ice Cave.

COMPARATIVE ISOTOPIC STUDY OF DIFFERENT TYPES OF ICE IN SCĂRIŞOARA ICE CAVE, ROMANIA

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One of the most reliable proxy records of paleoclimate in ice cores is the ratio of heavy vs. light isotopes of oxygen and hydrogen in water. However, questions regarding the significance of these ratios in cave ice for paleoclimatic reconstructions may arise because the external climatic signal recorded by the stable isotopes in precipitation might be altered by the cave's environment or partial melting of ice during the summer. Here we present a comparative study of oxygen and hydrogen stable isotope measurements in different types of cave ice from Scărişoara Ice Cave, Apuseni Mountains, Romania, and assess the value of this proxy in reconstructing past climatic changes.

Stable isotope measurements were performed on precipitation samples collected on a monthly basis between December 2004 and August 2006 in the vicinity of the cave, and on ice samples collected in four different settings inside the cave, as follows: i) newly formed ice from the top of an actively growing ice stalagmite - "stalagmite ice" (collected in January 2005), ii) newly formed ice from a frozen stream of water on the surface of the main ice body - "surface ice" (collected in January 2005), iii) layered ice formed during the freezing of stagnant water - "lake ice" (collected in January 2005 and 2008), and iv) ice samples from a 22.5-m long ice core drilled in February 2003.

The $\delta^{18}O$ values in precipitation are positively correlated with the air temperature (r^2 = 0.7), and the LMWL ($\delta^2H = 8.14*\delta^{18}O+10.227$) is almost identical to the GMWL.

Stable isotopes in ice show a smaller range of variability than those in precipitation, and differences occur among samples collected from different settings, indicating that the values are influenced by the time and style of ice development.

Ice in caves forms in two distinct periods: one in late autumn, and one lasting from winter through late spring. In autumn, the lake standing on the top of the ice block (formed by melting of ice and infiltration of rainwater) freezes downward from the top, to form a layer of stratified ice up to 15 cm thick ("lake ice"). During formation of lake ice a continuous enrichment in heavy isotopes of the ice and depletion of remaining water occurs. The freezing process results in a succession of layers of ice with decreasing δ values from the top to the bottom, but if melted, the resulting water will have an isotopic composition similar to that of the initial water.

Winter and spring ice forms as seepage waters progressively freeze in thin layers ("floor ice"), superimposed on the autumn ice or on top of ice

stalagmites ("stalagmite ice"). Eventually, all of the inflowing water will freeze, and the resulting ice will show a clear isotopic gradient, from heavier to lighter δ values along the flow-path. The differences between the stable-isotopic composition of floor ice and stalagmite ice are not significant, indicating that they form via similar freezing processes.
Stable isotopic composition of samples from the ice core plot on a line with a slope of 8.4 (compared to 8.13 for the LMWL), but with a slightly different intercept (13.4).
Based on stable isotope data and ice-dynamics monitoring, we consider that the ice block is built up mainly from lake ice, and that the isotopic composition of the ice reflects that of the water standing on the surface of ice at the beginning of freezing process in autumn, a mixture of late spring through autumn precipitation and ice-melt water (derived from previous winter's snowfall), thus making it suitable for paleoclimatic reconstructions.

DOBSINSKA ICE CAVE THERMAL-CIRCULATION SYSTEM IN THE LIGHT OF THE NEWEST STUDIES

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Comprehensive research on thermal - circulation system of the Dobsinska Ice Cave has been carried out during the years 2001 – 2007. Collected material was used for the construction of the detailed diagrams of internal cave air flow and for determining of the relations between the air circulation and the temporal-spatial diversity of the thermal conditions within the cave. In this paper, a summary of the research results is presented including the discussion over the thermal – circulation zones in the cave which were distingushed. The characteristics of these zones illustrate the cave microclimate dynamics and its role in the forming of the icing conditions in the cave.

STUDY OF TEMPERATURE AND AIRFLOW IN THE SCHELLENBERGER ICE CAVE (BERCHTESGADENER LIMESTONE ALPS, GERMANY)

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The Schellenberger ice cave is known since a long time and was first mentioned in 1826 in the Bavarian ordnance map. Since 1925 the cave is run as a show cave and to this day only illuminated by carbide lamps, as there is no access to electricity in this part of mountains. In addition, this cave can only be reached by a 2 ½ hours hiking trail with a difference in elevation of 1100 m. The biggest accessible ice cave in Germany is located at the Untersberg massif (1570 m a. s. l., total length: 2815 m) A big entrance leads to the biggest hall in the cave with a dimension of 70 x 40 m ("Josef-Ritter-von-Angermayer-Halle"). The floor of this hall completely consists of a approx. 30 m thick and 60000 m^3 ice block, which is surrounded by the show cave trail. At the deepest point of the show cave trail ("Fuggerhalle") the ice was dated through a pollen analysis of an age of 3000 years b. p. . Apart from the 500 m ice cave part there is one main non-ice part, which leads through several shafts to the deepest point of the cave (-210 m).

Although the cave is known since the late 19th century, no general investigations about the cave climate, glaciology etc. has been carried out yet. The former cave guide Fritz Eigert (†) collected data during his work from 1957-1986, which is presented by RINGEIS, GREBE et al (2007) in another paper. In 2001 the "Verein für Höhlenkunde Schellenberg e. V." installed two temperature data loggers in two halls, which will be also included in the new study.

In this paper we present the new measuring campaign, which will be part of a master thesis. In October 2007 3 temperature data loggers were installed in 3 different microclimate zones and different levels of the cave. Since there is no access for electricity and no possibility to enter the cave during the winter time because of danger of avalanches, it is planned to install sonic anemometers in spring 2008. This will be accompanied by a mobile measuring campaign from spring to autumn 2008, during which different parameters will be analysed. The aim of this campaign is to characterise different seasonal aspects in temperature and airflow regime, to define the climatic behaviour of the cave also in its interaction to the ice block and to define possible reasons for the strong melting of the ice block in some specific parts of the cave.

LED LIGHTING EQUIPMENT

Novomeský J.

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Presentation of special technical informations based on our own design and installation of cave and other lighting equipments with the new light sources – LED. They shoul'd help us to plan the new lighting equipments with much less power and maintenance and more friendly and inoffensiv to the caves enviroment in the future.

Suitable luminairs, design, installation, control and operation of lighting equipments. Something about the use of colours and the light effects.

NEW INTEGRATED MONITORING SYSTEM IN SHOW CAVES WITH ICE FILL IN SLOVAKIA

Zelinka J.[1], Omelia J.[2]

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A new integrated monitoring system was set up in the Demänovská Ice Cave in May 2007 and in the Dobšinská Ice Cave in October 2007. Its aim is a detail measurement, recording and storing of data of selected natural parameters of cave environment (temperature, relative humidity, slow air movement, temperature of bedrock in various depths) and outside atmosphere (temperature, relative humidity, precipitation). The system consists of a network of connected dataloggers, which process and store the measured data from sensors. Measured data are regularly transferred via GSM protocol to the centre with central database. A special software was developed for online remote control of dataloggers, including changes of measuring regime, processing, checking and storing the data. The monitoring system operates only a short time now with no substantial problems.

GEOGRAPHICAL DISTRIBUTION OF ICE-FILLED CAVES IN SLOVAKIA

Bella P.

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Karst areas of Slovakia are located in the Western Carpathians Mts. and several intermoutain basins within the temperate climatic zone in Central Europe with transitional features between oceanic and continental climate. The extent of karst areas is more than 2,700 km2. From the climatic and orographical point of view the high-mountain karst in the northern part (the highest positions of Vysoke and Belianske Tatry Mts., Cervene vrchy Mts., Dumbier Karst in the Nizke Tatry Mts. and other alpine elevations above the upper boundary of forets) and the mid-mountain karst in the western, central and eastern part of Slovakia (Male Karpaty Mts., Strazovske vrchy Mts., Velka and Mala Fatra Mts., Nizke Tatry Mts., Spis-Gemer Karst, Slovak Karst and other areas) are occurred.

At present, more than 5,450 caves are registered in Slovakia, mostly in carbonate rocks (limestone, travertine). On the basis of existing observations 40 permanently and 26 seasonally ice-filled caves are known in several geological and geographical conditions. In addition to limestone ice-filled caves, ice fill was observed also in 4 travertine caves and 4 non-carbonate caves as a consequence of varied geological settings of Slovakian territory.

The lowest located permanently ice-filled cave is Silicka ladnica (Silicka Ice Cave, Silicka Plateau) at 503 m a.s.l. in Slovak Karst, the highest located are Priepast v Hlupom vrchu (Abyss in Mt. Hlupy) at 1,966 m a.s.l. in Belianske Tatry Mts. and Ladova priepast (Ice Abyss) at 1,938 m a.s.l. in Cervene vrchy Mts. The ice part of well-known Dobsinska Ice Cave is located at 920 – 950 m a.s.l. The occurrence of permanently and seasonally ice-filled caves within hypsometric grades: 94 to 300 m a.s.l. – no caves; 300 to 700 m a.s.l. – 9 caves; 700 to 1,100 m a.s.l. – 22 caves; 1,100 to 1,400 m a.s.l. – 6 caves; 1,400 to 1,700 m a.s.l. – 16 caves; 1,700 m to 2,655 m a.s.l. – 13 caves. Compared with high-mountain and higher mid-mountain karst areas, the relatively numerous occurrence of ice-filled caves at 700 to 1,100 m a.s.l. (33.3 %) is resulted by large extent of karst areas in the hypsometric grade. The most of ice-filled caves is located in Vysoke and Belianske Tatry Mts. (28 caves), Nizke Tatry Mts. (11 caves) and Spis-Gemer Karst – Slovensky raj (Slovak Paradise) and Muranska Plateau (10 caves).

According to the classification of climatic regions of Slovakia (Lapin et al., 2002) the ice-filled caves are situated in the warm region (warm and moderately humid subregion with cool winter – 3 caves), moderately warm region (moderately warm and moderately humid subregion of basins with cold winter – 3 caves, moderately warm and moderately humid subregion of hilly land or highlands – 2 caves, moderately warm and very humid subregion of highlands – 1 caves) and the cool region (moderately cool subregion – 19 caves, cool mountainous subregion – 13 caves, cold mountainous subregion – 25 caves). The most of ice-filled caves are located in the cool region (91.7 %), the least in the warm region (3 %).

From the cave morphology and genesis point of view ice fills were deposited mostly in drawndown or levelled parts of inactive river caves (inside inclined pocket-like cavities originated by breadown in original passages or closing of lower entrances by slope sediments), crevice caves and abysses, also in corrosion or corrosion-collapsed vetical shafts.

The extent of ice fill in Dobsinska Ice Cave is ca. 9,770 m2, ice volume is more than 110,100 m3 (Tulis & Novotny 1995). The surface area of the cave is situated in the moderately cool (July ≥ 12 °C to < 16 °C) and very humid subregion (900 to 1,000 mm). The volume of floor ice in Demänovska Ice Cave is 1,040 m3 (Strug et al., 2005), in Silicka ladnica only 340 m3 (Rajman et al., 1987). The estimated volume of ice monolith and plug in Ladova priepast (Cervene vrchy Mts.) is ca. 650 m3, in Ladova priepast na Ohnisti (Ice Abyss at Ohniste, Nizke Tatry Mts.) ca. 525 m3 (Hochmuth, 1995).

All caves in Slovakia, including ice-filled caves, are as natural monumets lawfully protected by the Act on Nature and Landscape Protection. Many ice-filled caves are situated in nature reserves and national parks. The Dobsinska Ice Cave, Silicka ladnica and two ice-filled crevice caves in Slovak Karst are included in the World Heritage (in the framework of Slovak-Hungarian site Caves of Slovak and Aggtelek Karst).

GEOGRAPHY OF CAVES GLACIATION

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In the base of caves glaciation mapping are put following principles of caves glaciation dependence from: 1) Morphology of cavities. There are three basic types of the cavities with glaciation: horizontal with entrances at different elevations, inclined descending, vertical with snow accumulation. Other cavities with glaciation can be presented as combination of these basic types. 2) Climate of studied area. A major factor influencing on caves glaciation is average long term temperature of the coldest month (January for northern hemisphere and July - for southern). 3) Temperature conditions of the rocks massif containing cavity. On the average the rocks massif temperature differs from mean annual temperature (MAT) from 0 up to 7°C, increasing deep into continents. For simplification of mapping we accept average size of this difference about 3°C. The analysis of available data for caves with glaciation in different regions has allowed to receive caves glaciation index (CGI). Value of CGI is determined from the equation CGI = - Tj/(Tm – Tj), where Tj - average monthly air temperature of the coldest month of year (January or July), Tm - temperature of rocks massif containing cavity. At superficial position of karst cavities Tm can be approximately define as Tm= MAT+a, where MAT - mean annual air temperature of area above cavity, a - an additional member, which value is accepted equal 3°C. Thus CGI is the factor showing a degree of possible cooling of rock massif due to outside winter air temperatures of: the higher CGI value, the greater degree of cavities cooling is possible. Caves glaciation is possible in areas where CGI has positive values. At the permafrost boundary (i.e. at Tm=0) CGI has value 1,0 and CGI=0 on a zero isotherm of average January (July) air temperature. There are following gradation of CGI depending on character of caves glaciation: where CGI has values from 0 up to 0,25 the seasonal caves glaciation is developed only, where CGI changes from 0,25 up to 1,0 permanent glaciation in separate caves is developed except of seasonal one. For areas where CGI exceeds 1,0 the constant glaciation of the majority of caves is characteristic. Boundaries of caves glaciation in mountains will line similarly. The southern boundary of distribution of permanent caves glaciation is various for cavities of different types and is lined at following CGI values: for horizontal caves at CGI=0,7; for inclined descending caves – at CGI=0,25; for vertical caves – at CGI=0,3. Such principles have allowed to construct map of caves glaciation on areas of all continents. It is discussed map "Caves glaciation of continents" on which are shown contours of CGI values. The same principles were possible to use also for construction of caves glaciation maps in the past. For this purpose it is enough to know the character of distribution of MAT and temperatures of the coldest month of year for areas interesting us. Modern paleogeographical researches allow to obtain distribution of the named temperatures in areas of continents during the certain periods in the past. It allows to construct maps of caves glaciation for these periods. "The Map of caves glaciation for continents at climatic optimum of Holocene" is discussed and its differences from a modern map of caves glaciation are analyzed.

MEASURING OF THE THICKNESS OF PERENNIAL ICE IN KUNGUR ICE CAVE BY GEORADAR

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Before this moment, there was surely known only area of perennial ice in Kungur Ice cave. In February, 2008 there were conducted researches by specialists of Mining institute for estimation of volume of ice deposits. For researches has been used georadar "Oko-M1". Measures conducted in the rooms where perennial ice body reaches the maximal thickness and in the passages where measured depth of course of ice into the cracks in the rock, containing the cave. In all, in the "Polarniy" room has been laid 4 profiles, in passage "Gore Tolstyakam I Vysokim" – 2 profiles, in the passage between rooms "Brilliantoviy" and "Polarniy" – 2 profiles and in "Dante" room – 1 profile. After measuring it has been revealed that maximal thickness of ice body in "Polyarniy" room is about 2 meters and minimal one – 0.2 m. The depth of course of ice into the cracks in the rock everywhere is exceeds for 6 meters.

ICE FORMS IN BOLSHAYA MECHKINSKAYA CAVE

Khudenkih K.[1] , Naumkin D.[1]

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Bolshaya Mechkinskaya cave is situated in 20 km to the north from Kungur town. It occurs in the range of gypsum-anhydrite stratum of Iren horizon of Kungur stage of Perm system. The cave is known to locals already more than 100 years.
Total length of the cave is 350 m. Cave consists of five rooms. Ice formations are present only in two first rooms. The main feature of the cave is a huge column in Bolshaya (Big) room. It has about 6 meters height and 5.6 meters in circumference. In Bolshaya Mechkinskaya cave can be met a big variety of ice crystals of different forms, stalagmites and stalactites. Ice crystals also exist and in the pre-entrance part of the cave. In this part also meet "ice curtains". In winter of 1996 in the cave was ice "waterfall", but this year it is not found.
In the second room ice forms are also presented by stalagmites and stalactites but their sizes are significantly less than in the first room. On north wall of this room has been found small "ice curtain".
There is evaporation from surface of some stalagmites, and, as a result, there is formed the "gypsum meal". In spring of 2007 some samples of this "meal" has been taken from some of stalagmites of Bolshaya room and in pre-entrance zone. These ones were sent for analyses to Silezia university (Poland). Results of analyses will be published later.
Lakes of the Bolshaya Mechkinskaya cave are inhabited by local specie of amphipods - Crangonyx chlebnicovi. The cave has a status of geologic reserve of nature of Kungur district of Perm region. This cave is widely known as an object of tourism.

GEOCRYOLOGICAL CONDITIONS AND ICE CAVE OF NORTH PART OF ARCHANGELSK REGION (R. PINEGA, R. KOIDA)

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On geocriological to division into districts cryolithozone of northern part of r. Koida (Archangelsk region) is submitted island and rare spread by types of distribution of permafrost last Holocene age (temperature of permafrost -0,5 - -1,0 º C). Thickness of them can achieve 25 m and more. Permafrost are dated basically for peat deposits. In area of r. Koida permafrost are found out in flat-topped tundra bogs (capacity of peat is from 0,4 up to 1,0 m) and in peat frost heave mound tundra (capacity of peat is on the average 2,0 - 3,0 m). On flat bogs observed two-layer structure of permafrost. Top layer (active layer) of permafrost - is low-power, dynamically varied during a season. In the winter period his top of permafrost coincides with a surface of mound, average capacity seasonal thawing layer in October achieves 0,55±0,04 m. In mound tundra of r. Koida especially widely advanced on Abramovskiy coast, the height of segregated frost heave mound (palsa) achieves 3 m, that alongside with the big capacity of peat adjournment allows to assume here rather intensive development of permafrost. So, in coastal breakages are marked superpose layer of ice and snow deposited in peat's by thickness up to 2 m. In region various cryogenic processes (thermokarst, thermoabrasion, thermodenudation, solifluction) are observed.
The development criolitozone in caves of r. Pinega (Archangelsk region) is caused by a number of the factors connected to morphology of cavities, by their hydrodynamics and microclimate and is subordinated latitude of ash value. The features spatial - temporary distributions of ice caves are subordinated to dynamic parameters of carst systems. Within the limits of considered territory the ice formations caves of all genetic classes in a wide spectrum them specific of a variety and morphometry of displays are established. The ice entrance of sites caves, in zones negative T 0, having extent up to 100 - 200 m are most significant on volume. In the zones, removed from entrances, the development of ice is caused local flow of cold air, or affinity of a site of a cavity to wall to a zone. A role metamorphorical and sublimation of ice subordinated. The features of chemical structure of underground ice are connected to high speed of dissolution sulphate of rocs, activity of circulation of waters in limits carst of a file. The ice with mineralization up to 0,8 - 2 g/l prevail SO_4Ca. On the data speleomonitoring in Pinega reserve the greatest influence on safety of ice is rendered by freshet waters. The majority caves is fragments of transit or transit - unloading constant or seasonal underground waterflow, destroying ice formation with mechanical and temperature influence. The maximal age established for caves of ice makes 200 years. As a whole,

tendency of reduction of volumes of ice formations nowadays is marked. The ice - cements raise stability carst of a file, that in conditions is strong crack of rocs considerably to prolong time of existence caves.

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POSITIVE FEEDBACK MECHANISM OF COLD AIR GENERATION IN ICE CAVE AND ITS USE.

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The mechanisms that cold air is generated and water refreezes in ice cave were investigated. When warm air contacts to ice, it melts and air warms. However, it is found that colder air than ice can be generated only when much cold air than ice contacts to ice and sublimates ice to vapor. By way of this mechanism, it is possible that water in cave can freeze in summer if colder air is trapped long time in higher place of the cave in winter. Also in winter if cold air penetrates into cave slowly, melting will be weakened and the more ice can be produced. The boundary value of the meteorological differences between ice and air that decides melting or sublimation was considered. Not the relative humidity but the dew point value near ice makes solution.

IKAITE IN THE SCARISOARA ICE DEPOSIT: PRECIPITATION AND SIGNIFICANCE

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Ikaite is a rare metastable carbonate mineral first identified in submarine reef-like columns growing from the bottom of Ika Fjord (SW Greenland) at temperatures between -1.9 and 7ºC. Inactive tufa towers found along the shore of Mono and Pyramid lakes in western United States are believed to represent former ikaite structures that were converted to calcite. A 1996 note reporting ikaite forming during the winter months in ice and icicles around some saline springs from Shiowakka, Hokkaido Island (Japan) along with its identification in sea ice prompted us to search for this rare mineral that is a marker for near-freezing water temperatures in the ice deposit of Scarisoara Cave. A reconnaissance mineralogical study undertaken in 2001 pointed out the presence in the periglacial environments (nearby the ice block) of fibrous efflorescent (soft and moist) lublinite as well as monohydrocalcite. The former (along with sub-millimeter size calcite crystals) are deposited during cryogenic processes, whereas the latter one is precipitated in an aerosol-rich environment in which temperature changes seasonally (below 0º from October to April and slightly above 0ºC in the rest of the year). Two types of ikaite were positively identified by XRD and environmental scanning electron microscope studies: 1) euhedral crystals (< 200 µm in diameter) forming a white-light cream moist mineral powder within certain ice layers and 2) glendonite-type calcite pseudomorphs (mainly rhombic and pyramid faces). Yet, without having done any detailed studies (chemistry of the percolating water and ice) we believe ikaite is cryogenically precipitated within the ice deposit in Scarisoara Cave. This preliminary conclusion is based on the stable isotope measurements on two ikaite samples that showed enrichments in ^{13}C of up to +8.7‰ over the equilibrium values. This is similar to the typical values found for cryogenic carbonates (in Scarisoara Cave and elsewhere) formed during rapid water freezing that is accompanied by swift kinetic CO_2 degassing. The calcite pseudomorphs after ikaite (glendonite) were found at the limit of the ice field in the Big Reserve and their presence seems to be indicative of near-freezing conditions for water and hence useful as paleothermometers, providing a good calibration is established. Future work on such material may shade light on the relationship between the oxygen isotope values in the ice layers and ikaite's temperature-restricted field of formation. Then we can exploit the potential of $d^{18}O$ in its hydration water to cross-calibrate with the $d^{18}O$ obtained from ice layers that contain ikaite.

ANALYSIS OF ICE LEVEL MEASUREMENTS IN THE SCHELLENBERGER EISHÖHLE IN THE GERMAN ALPS

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The association of german cave and karst scientists has recently proposed to set up a data archive for cave climate data that has been collected during the past years and decades in several german caves by local cavers or caving groups, so the data will not be lost and may be used for future studies on cave climate. Among these older measurements is a time series of icelevel measurements from the Schellenberger Eishöhle in the German Alps near Marktschellenberg in 1570 m above sea level. The data was collected by a cave guide during the summer months, when the cave is accessible and open to the public as a show cave.

Just now also a new cave climate mearsuring programme is being under way at the Schellenberger Eishöhle.

For these two reasons - data backup und new research in the Schellenberger Eishöhle – the icelevel measurements are now being analysed.

At first the problems and chances of using data that has been collected some time ago will be discussed on the example of the data from Schellenberger Eishöhle. The difficulties here lie in the missing or incomplete documentation of how and where exactly the data was collected.

Then the analysis of the icelevel measurements will be presented. The focus here lies on the magnitude of change in icelevel on an inter- as well as an intra-annual basis and on the relation between icelevel change and outside air temperature and precipitation.

DC RESISTIVITY AND TEMPERATURE MEASUREMENTS IN DACHSTEIN MAMMOTH CAVE (NORTHERN CALCAREOUS ALPS, AUSTRIA)

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During the last decades processes in ice caves were studied by numerous scientists. Nowadays the occurrence of subsurface ice becomes more important since information on past climate variability might be recorded within distinct ice layers. However ice age, origin, formation and variation of subsurface ice are not yet fully understood. DC resistivity seems to constitute one of the key parameter for characterizing different types of ground ice. Thus the formation of congelation ice, sedimentary ice or metamorphic ice might correspond to ice with low-/high/- or extreme resistivity. In addition specific resistivity is useful to model waveforms for GPR (ground penetrating radar) investigations.
In this study DC resistivity and (ice-) temperature measurements has been conducted in the Dachstein Mammoth Cave (Northern Calcareous Alps, Austria). Ice fillings in Dachstein Mammoth Cave are located in-between two entrances situated approximately 1400 m a.s.l. DC resistivity was applied on a massive ice body of 8m width and 20m length, and also on the sedimentary ground next to this body. To overcome the high contact resistance a special coupling was necessary to inject the current into the ice body. Since most of the common DC devices are not able to measure resistivity more than several MΩm we separately injected the current and measured current and electrical potential manually. An apparent resistivity of 1 kΩm was calculated for the unfrozen sediment layer beside the ice body and about 10 MΩm for the massive ice layer. Strong polarization effects up to 10 minutes were observed until the value for the current get stable. Since the specific resistivity is also controlled by the ice temperature, the latter one was also observed. Ice temperatures, measured on two points below the surface and at one point on the surface of the ice body, showed a permafrost-like depth dependency with a minimum value of about -3°C on the top. Air temperature measurements were observed at two locations over periods of 23 and 38 months, respectively. The thermal regime is characterized by mean annual temperatures of +4.3°C for the exterior (entrances) and -0,5°C were ground ice exists. The temperature data show rather constant values between 0°C and +1°C from May to November. From end of November to end of March cold temperatures from the exterior penetrate the cave system and low temperatures up to -8°C (Tristandom) and -2.5°C (Saarhalle) are observed.

THICKNESS AND INTERNAL STRUCTURE OF SUBSURFACE ICE FROM GPR INVESTIGATIONS IN THREE ALPINE ICE CAVES

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The Northern Calcareous Alps (NCA) in Europe host a large number of ice caves. In the frame of the pilot study AUSTRO*ICE*CAVES*2100 various methodologies have been applied to investigate the structure, age, and formation of subsurface ice. This presentation shows the results of Ground Penetrating Radar (GPR) which is used to investigate the thickness and internal structure of ice bodies in three ice caves located in the NCA of Austria (Eisriesenwelt, province of Salzburg; Dachstein-Mammuthöhle and Dachstein-Rieseneishöhle, province of Upper Austria).

Shielded antennas with relatively high frequencies (500 MHz) were used to penetrate the ice up to 15 m depth. Additionally, a 1.2 GHz Antenna provided high-resolution images up to 2 m depth. 3-D layouts (crossing profiles) were necessary to delineate the strongly curved subsurface in detail and to verify that certain reflections in the radargram sections originate from the subsurface. In almost all radargram sections the lower boundary of the ice body is identified by the onset of strong and sharp reflections. We attribute this to either increased humidity at the ice – rock contact (due to melting) or to a sedimentary layer between ice and rock. The maximum ice thickness is 7.5 m in Eisriesenwelt, 6 m in the Dachstein-Mammuthöhle and 15 m in the Dachstein-Rieseneishöhle. The propagation velocity of the ice bodies (0.165 m/s) is close to the velocity of temperate glaciers.

Pronounced layering of the ice body itself is clearly seen in various radargrams as well as at locations where ice walls are directly accessible. This layeríng presumably arises because of variable air and/or dust contents and its origin is being investigated by forward modelling of different strata models (e.g. alternating air content, conductivity variations due to inclusion of sedimentary layers). Results from an ice core are used to validate and calibrate the GPR models.

KUNGUR ICE CAVE AS A TOURIST RESOURCE OF RUSSIA

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Caves and karstic hollows which keep constant ice formations in temperate climate are very specific tourist objects. Among them there is a small group of caves specially equipped for leading excursions for tourists without special speleological preparation. There are only five such excursion caves all over the Russia, and only one of them Kungur Ice cave having long-term ice formations. This cave is located in Urals, near the border of Europe and Asia, practically in the middle of the Euroasian continent. The absolute mark of its input is 119 m. On such heights its no excursion caves with constant ice formation all over the world. Process of ice accumulation in the cave occurs during the cold period (below 5 degrees of Celsius) which lasts more than 200 days for a year.

This cave is used by people, since 9 centuries. It is the oldest in the world excursion plaster cave with a long-term glaciations. For excursions the cave is equipped since 1914. Average attendance last decade makes the order of 800000 people for a year. Length of the basic tourist track is 1300 m. Duration of ordinary excursion is 1 hour 20 minutes.

Regular excursions visited starts since 1914. More than 4,9 million person visited the cave, from the time when statistic account of visiting's starts. In comparison it is twice more than the population of the Perm region. Now every year about hundred thousand person comes to Kungur for observing the ice cave (the population of city is only 68 thousand people). This ice cave is known all over the world, and many foreigners associate Perm region with Perm geological period and Kungur ice cave (the exposure is a stratotype of Perm period). The cave is located near the Trans Siberian railway and many foreign tourists do a special stop for survey the cave. In this case the best choice for our visitors is individual two-hour excursion in the cave.

It is written about 100 popular scientific and over 500 scientific works about Kungur Ice cave. It was 1703 when Peter the Great sent noted scientist geographer S.U. Remezov from Tobolsk to Kungur. He made the map of district and the first plan of ice cave. Copies of this plan have been multiplied by cartographers in XVIII century and included in scientific encyclopedias of 12 European universities. So the scientific Europe society has started investigation of the underground world from our cave.

Now the excursion caves in the Europe are numerous in number, but our cave is well known among them. The session of the European UNESCO commission recognized Kungur Ice cave as completely corresponding to all criteria for including it in list of new places for historical-natural heritage (so it is one of 7 objects selected from 30 nominates).

Unfortunately, caves as a tourist resource in Russia, are used insufficiently well. The cadastre of caves of Russia is not created. According to expert estimation in Russia is about 100000 caves, from them in Urals Mountains more than 2 thousand, and in Perm region nearby 700. Now many caves are visited unorganized because it is no special official documents which regulate excursion and tourist business in caves. Now all caves according to the "Law on bowels in Russian Federation" are considered as dangerous industrial objects. Today the system of Kungur Ice cave monitoring is unique for caves research in Russia. Looking forward we shall overcome the difficulties and in this case the experience of Kungur Ice cave investigation and exploitation, will be useful for organizing tourist operation in other Russian excursion caves.

DISTRIBUTION AND CHARACTERISTICS OF ICE CAVES IN SLOVENIA

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The article presents the basic information on the appearance of caves with perennial ice and snow in middle latitude (46° H, 14°E) karst of Slovenia. The lowest lying ice cave has entrance at 645 m a.s.l. and the highest at 2434 m. The number of caves increases with elevation, but the main reason for perennial ice is shape of the cave entrances and the general relation between karst surface and underground which defines the air circulation in caves. There are 551 caves with perennial ice and snow, but there are also several times more caves where winter ice remains deep into summer. There are several cases, that caves, cooled in the winter, are advecting cooler air in warmer part of the year into karst depressions, causing significant drop of temperature in them and preserving the snow in them deep into summer.
However, most of ice caves are simple shafts where ice and snow in most cases accumulate in entrance parts. Caves where perennial ice is formed away from the entrances are rear. There are oscillations of the ice in caves recorded, but the observations are sporadic and it seems that there is no one common response to annual variations of climate.
Ice caves are important from economic point of view, in past they were sources of water an ice and now one of them is managed as a show cave.

CAVE ICE OF THE CHELYABINSK REGION (A BRIEF REPORT)

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In the Chelyabinsk region there are seasonal and permanent snow-ice formations, which belong to two main types - sublimation and congelation. Sublimation crystals of the different form and the sizes it is possible to meet in caves closely to entrance and they are seasonal (exist from the beginning of winter up to the end of spring). They are noted in caves: Sukhaya Atya, Plutoniya, Kiselevskaya, Essumskaya, Ignat'evskaya, Shumikha, Kurgazakskaya, Sugomanskaya, Shemakhinskaya 1 and 2, shaft Udznaya. Among congelation ice there are stalactites, stalagmites, stalagnates (ice dripstones), cover icings (naleds), and also an ice of cave lakes and rivers. Seasonal ice dripstones from 2 - 3 cm up to 2 - 3 m of length or heights and up to 0,5 m in diameter are noted in caves: Kiselevskaya, Shalashovskaya, Podzarnaya, Ogurtsova, Majskaya, Kolokol'naya, Belaya Tsaritsa, Shumikha, Kurgazakskaya, etc. Ice stalagmites of a cave Sukhaya Atya have height up to 2,5 m, and in grotto Unoshevskij - up to 5 m. Seasonal ices on the underground rivers and lakes are fixed in caves: Essumskaya, Vodnaya, Shumikha, Shemakhinskaya -1. Icings are formed on walls and on the floor of galleries, have thickness from several centimeters up to several meters, happen seasonal and perennial, to precisely expressed layers of accumulation. Permanent icings are noted in caves: Sukhaya Atya, shaft Snedzinka, Ledyanaya Yama, Bolshaya Pokrovskaya Yama (Shaft - 47), Sukhokamenskaya (Ponornaya), Kurgazakskaya, Ledyanoj proval, shaft Udznaya. In cave Sukhokamenskaya icing has an anthropogenous origin. In a cave Kazachij Stan in 2005 lake ice of previous year has divided a through dynamic cavity into two isolated «cold bags» that has led to formation of permanent ice. Icings are noted also in artificial cavities. Caves glaciation of the Chelyabinsk region practically is not studied and demands attention of scientists.

BLÖDITE $Na_2Mg(SO_4)_2 \times 4H_2O$ – IS THE FIRST FIND OF EPHEMERAL MINERAL IN KUNGUR ICE CAVE

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Since 2005 by us in Kungur ice cave are studied seasonal or ephemeral mineralizations (Potapov, etc., 2006). Minerals of a class of sulfates concern to them with variable quantity kristall waters. It is kristallohydrates, sulfates of calcium, sodium and magnesium. To ephemeral formations the fibrous white units growing subperpendicularly of a surface of a substratum concern observable on a ceiling and walls of some grottoes of a cave. Earlier some researchers named similar formations «a gypsum moss» or « gypsum down» that is quite fair as the material basis of these units is made really with gypsum, and morphology it reminds easy white down. Similar formations, in particular, were observed earlier in a southwest wing of a grotto Polar. In March, 1998 by our predecessors here has been established thenardite $Na_2(SO_4)$ (Максимович, e. a., 1999). Authors marked, that on the conditions reigning in a cave, thenardite could not be formed in it initially, therefore write: «… it is natural *to assume*, that the initial composition of fibrous new formations was mirabilite». Anyway, but authors have only assumed an opportunity of formation of mirabilite in Kungur cave, but authentically a find have not confirmed. The first authentic find of mirabilite $Na_2(SO_4) \times 10H_2O$ has been made by us on March, 4, 2006 at transition of a grotto the Collosseo in a grotto Smelych (Potapov, e. a., 2007). Here near a tourist track on ground from the left party fragments of gypsum breed with plentiful fluffy new formations with length of fibres of down on the average 15 mm and with the maximal length 20-25 mm are found out. These samples have been tightly packed, and in laboratory conditions their preparation with vaseline (in avoidance dehydratation is prepared and the roentgenogram corresponding mirabilite with an impurity of gypsum is received. In July, 2007 at audit of mineral formations in a grotto Polar on a ceiling and walls we find out silky white mineral formations which roentgenogram corresponds to blödite $Na_2Mg(SO_4)_2 \times 4H_2O$ with an insignificant impurity of gypsum $CaSO_4 \times 2H_2O$. It was the first find of a mineral in Kungur ice cave. The main lines of blödite on the roentgenogram is: 4.660, 3.178, 3.074, 2.782, 2.644, 2.328, 1.863 Å. For the first time blödite (other, out-of-date, not nomenclature name of a mineral is astrakhanite) has been found out by D.I.Sokolov in 1769 in adjournment of hydrochloric lakes of Zauralye. It is typical an evaporite mineral. It meets and in technogenic conditions. Frequently associate with thenardite. The embodiment in specific snow-white cotton wool- or down like unequivocally does not specify the mineral unit, that it new formation is executed mirabilite or blödite. On our supervision more often they are executed by gypsum, and gypsum as steadier and less soluble mineral, is in them «through» whereas thenardite, mirabilite or blödite can exist in this unit only at narrowly limited parameters of environment, i.e. are typical ephemeres formations. As to the genesis of formation gypsum, gypsum-mirabilite, gypsum-blödite fluffy units hardly they are aerosol formations. Needle character of mineral individuals in the specific fluffy unit could be formed at any «hypsometric» level (on roof, walls and as appeared, even on ground of a cave) at a capillary feed through a rocky substratum accordingly by mineralisacion solutions. Work is executed at support of the grant of the RFBR № 07-05-00618.

ICE CAVES IN CARBONATE ROCK OF BASHKIRIA

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Ice caves are known in Paleozoic limestone and limestone dolomites and are spread mainly in central part of Bashkir Ural, in zone of western front ridges, on Ufa plateau, in Bashkir Zauralye and some of them occurs in the pre-Ural deflection.

The first data about ice caves of western slope of Bashkir Ural are dating as ago as in 1770 when Russian traveler I.Lepehin has visited and described three of them: Mainak-Tash, Biyslan-Tash and Tyrmyan-Tash. Askynskaya Ice cave that had been explored in 1923 is very interesting. The cave has shape of huge room length of 100 m., width up to 60 m. and height up to 15 m. On the bottom of this room in frozen tuff-limestone were found the numerous bones of modern animals and human's bones.

From seventeen caves which are occurred in gypsum and anhydrite on the platform, nine ones are the ice caves and eight of them are situated on level of local rivers. On peripheries of Bashkir anticlinal among Paleozoic carbonate rocks exists 12 ice caves, on Ufa plateau - 2 and in Zauralye - 1. The most of ice caves are situated on levels 200-300 meters above sea level. In the central part of ridges line, with absolute level 600-700 m. above sea level, ice caves were not found.

All the caves with ice have the shape like bag that makes possible to save constant ice deposits.

Origin of ice inside caves is atmospheric and from condensation of water steams and snow.

MOUNTAIN FLOUR ON ICE STALAGMITES OF PINEGA CAVES

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In 2003-2004 one of authors in a number of Pinega caves (Kitezh, 60 years of October, Pekhorovskaya, Kulogorskaya-Troya, Pevscheskaya estrada) have been selected 10 samples of a mountain flour from the stalagmites, stalagnates and integumentary ice. Also tests of water from dissolution of integumentary ice, stalagmites and stalagnates from a cave Kitezh have been analysed. pH waters neutral or alkalescent. Waters are sulphate-hudrocarbonate-calcium. The contents of calcium close or hardly above 600 mg/l; a sulfate-ion - about 1400 mg/l and a hudrocarbonate-ion varies from 61 up to 146 mg/l. General rigidity varies from 29.5 up to 32 mg-equ/l. It is abnormal low mineralizations test of water from dissolution stalagnate has: Ca^{2+} - 108 mg/l; SO_4^{2-} - 192 mg/l; HCO_3^- - 73 mg/l, rigidity of 5.4 mg-equ/l. Sampls of a mountain flour represent friable powder-like substance from white up to grey color. Some sampls contain a clay component. The mineralogical analysis (diffractometer DRON-2.0, CuK_α-radiation) has shown, that a basis of a mountain flour is gypsum. Frequently similar mineral formations name a gypsum flour. In this case it is quite lawful. But the composition of a similar substance is not limited only to gypsum. Therefore it is primary, not knowing mineral composition of a flour, it is necessary to adhere more to the general term - «a mountain flour», on an image of «a mountain or lunar milk» - a viscous-plastic substance which composition is not limited only calcite, or gypsum. In more strict scientific terminology (after V.Andrejchuk, e. a.., 2004) similar mineral forms in view of their genetic nature should be named cryogenic formations as their formation is caused by processes of freezing and it is connected directly to formation at negative temperature of ice from dripping, exuding or current water in conditions of caves. Work is executed at support of the grant of the RFBR № 07-05-00618 on a theme «Mineralogy and ecology of caves of carbonate and a sulphate karst of Ural, natural and technogenic stalaktitegenesis».

MINERALOGY OF KUNGUR ICE CAVE

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Kungur ice cave (KIC) - a difficult polygenic natural geological complex in which and now occurs mineral formation. Below according to the standard systematization on classes of chemical compounds in view of literary given and own researches of authors the brief description of the minerals found out in a cave is resulted.

Oxides and hydroxides. Ice - H_2O in the cave represents as different forms:

1. Speleothems - stalactites, stalagmites, stalagnates and powerful covers;
2. Sublimation crystals of different shape.

Quartz - SiO_2 meets as grains in structure of the sandstone which has been found out in a thickness of sedimentary breeds. Also quartz is found out on sites of a condensation of tectonic cracks where he is introduced from overlapping sediments by waters. Pyrolusite - MnO_2 it is mentioned in the list of minerals KIC, but a concrete site, conditions and forms of formation of it it's not specified. Goethite - a-FeO(OH) it is mentioned in the list of minerals KIC, but a concrete site, conditions and forms of formation of it it's not specified. Magnetite – $FeO \times Fe_2O_3$; maghemite – γ-Fe_2O_3; lepidocrocit - γ-FeO are found out by us in composition of technogenic stalactites on steel designs. *Carbonates.* Calcite - $CaCO_3$ for KIC it is characteristic as crusts on a surface almost all lakes. Also calcite it is formed as crusts at evaporation of film solutions on a surface of porous anhydrites and gypsum. Still calcite unusual tubular formations at the bottom of the shoaled lake in a grotto Long which form a bush are submitted and grow upwards, probably, due to a feed of porous solutions. Meet and technogenic calcite speleothems as the stalactites-tubules formed from a cement mortal of retaining artificial walls. Calcite are submitted influvial fragments of limestones of the overlying thicknesses, got in a cave at betrothal. Dolomite - $CaMg(CO_3)_2$ is the basic mineral of spreading thickness philippovskiy horizon. Also he meets in structure crast on a surface of lakes together with calcite and as romboedres in carbonates deposits an impurity of clay. *Sulfates.* Anhydrite - $CaSO_4$ one of minerals of initial thickness of rocks in which it is incorporated KIC. Also there are looses capacity up to 1 sm from crystals of the anhydrite which sometimes has tested secondary crystallization. Gypsum - $CaSO_4 \times 2H_2O$ as well as anhydrite is a mineral of initial thickness of rocks. Also meets as secondary formations to which such versions of gypsum as selenite concern, mar'ino glass, needle crystals, gypsum roses and so forth. Barite - $BaSO_4$ is mentioned in KIC, but a concrete site, conditions of formation and forms of allocation of it is not specified. Celestine - $SrSO_4$ it is found out in calcite secretions which were formed in cavities of lixiviation fragments carbonates breeds as a result of evaporation of the sulphatic waters enriched with strontium. Thenardite - Na_2SO_4 really fixed mineral phase of seasonal mineralizations as fibrous units of needle crystals. Mirabilite - $Na_2SO_4 \times 10H_2O$ the phase really fixed by us on 4 March 2006 representing fluffy formations of white color with length of fibres of down from 15 up to 25 mm. Blödite - $Na_2Mg(SO_4)_2 \times 4H_2O$ for the first time for KIC has been found out by us in July, 2007. He is formed on a ceiling and walls of a grotto Polar as silky white mineral units.

THE INFLUENCE OF EXTREMELY DIFFERENT EXTERNAL THERMAL CONDITIONS ON THE ICE FORMS OCCURRENCE IN SLOVAK ICE CAVES IN THE 2005 – 2007 PERIOD

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In March 2003 the research of thermal conditions of the ice forms development and degradation in both the Demänovská Ice Cave and the Dobšinská Ice Cave in Slovakia started. The range of the ice forms occurrence, layout and durability in the ice caves is closely related to the course of air circulation, on which the exchange of heat in their interior depends. In the 2005-2007 period, the winter conditions in the surroundings of the caves were completely different as regard their thermal character. The winter season of 2005/2006 was very freezing but the one of 2006/2007 was unusually warm. Such extremely different exterior thermal conditions influenced on the different range of cooling of the cave interior. In both studied cases of two different ice caves not only was there extremely distinct course of the ice forms development and degradation but also the range of their ocurrence and the quantity of the ice monolith mass balance noted.

RESEARCH OF ICE SEASONAL FORMATIONS AND THE PROBLEM OF PRESERVATION OF PALEOLITHIC PAINTINGS IN THE SHULGANTASH (KAPOVA) CAVE

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Ice leak and sublimation formations are available in abundance during winter in the Kapova cave, in the area near the entrance. They are formed in November, start to thaw in March, and disappear completely in April. Zoning of the development of ice leaks is observed: in the entrance grotto, large stalactites – icicles are formed, on the western wall of the Portal, above the Blue Lake, a large cascade ice mound is formed, but the lake itself doesn't freeze. Along the western wall of the grotto, flattened leaks of complex shape are formed.
Further and deeper into the cave, at the beginning of the Main Gallery and in its central part, the largest leaks are formed: a multitude of erect stalagmites – "candles", up to 4 metres, stalactites and figured stalagmites, which frequently grow together to form stalagnates, and an ice mound on the wall. Formation of a large mass of ice in the Main Gallery results in frost penetration in a sector near the entrance. It causes the effect of "cold plug", which impedes penetration of warm superficial flow into the depth of the cave, where circulation according to a winter scheme still continues in the internal zone.
Formation of stalagmites of "hemipterous" type in our opinion indicates on large volume of cave providing intensive circulation according to type of "double loop" and considerable reserve of internal heat. Thus, a forecast of a great volume can be made, based only on the presence of such leakages in the entrance grotto of an unfamiliar cavity.
On the ceiling of the Main Gallery, in winter, large sublimation ice crystals are formed. Certain zonality is observed in their development: in the middle part of the gallery – in the area of a new staircase and copies of drawings, there is observed biofouling of the edges of pyramidal crystals with crystals of rectangular shape and crystals of gutter and other shapes are also found. Dimensions of ice crystals reach 3-4 cm.
Investigation of the dynamics of seasonal ice formations has great practical significance for the development of a method for microclimate correction to preserve the unique paleolithic paintings in the cave. Long complex monitoring of dynamic parameters of the speleological system, the basis of which is formed by microclimatic and hydrological observations, allowed us to proceed from research of the microclimate and a hydrological mode of the cave to correction thereof.
The acquired materials allowed us to develop and implement the project of a regulated excursion route in the area near the entrance of the cave,

where professional copies of the most interesting ancient drawings are represented. The internal areas of the cave with original drawings are protected by a special gate and tightly guarded.
The leading role of the cave as a unique archeological and historical memorial requires a change in the regulation of the cave. With reservation by the State Reserve of Functions of Object Protection, creation is necessary, of a specialised Historical-Archaeological Landscape-Speleological Museum-Reserve Shulgan-Tash.

THE THERMAL BALANCE OF THE ICE PART IN THE DEMÄNOVSKÁ ICE CAVE (SLOVAKIA) IN THE 2005 – 2007 PERIOD

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Both the intensity and duration of the winter air exchange between interior and exterior environments of the cave have the basic significance for the existence of the ice monolith and decide about the level of cooling in the cave. The outside atmospheric conditions during other seasons have minor significance because of the relative isolation of its atmosphere. The interior of the cave in the winter half of a year is cooled mainly by the sensible as well as latent heat flux. The sensible heat absorbs the heat of the rock and ice mass by the inflowing freezing air. On the basis of the measurements of air temperarute, air humidity and the ice mass volume, which all were taken in the Demänovská Ice Cave in the 2005-2007 period, there was the analysis of the components of the ice part thermal balance carried out. The thermal balance of the ice part in the contrasting winter seasons 2005/2006 and 2006/2007 shaped the ice mass balance very differently.

THE PECULIARITIES OF TEXTURE OF CONTACT ZONE FREEZE IN KUNGUR ICE CAVE

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The scientific observations are conducting in Kungur Ice cave more than 300 years. The hydrogeological, hydrochimical, microclimate and other investigations are indicators of detailed study of this unique nature object. The investigation of icing in the cave and the evolution of one is a valuable contribution in investigation of air regime of rock and temperature anomalies. However, the processes, which occurring on the boundary of icing, are remained without attention.

In the room Ruins (length 93, width 23, height 5, distance from entrance 250 m) lies a boundary of zero temperature. After that air stream is coming into low passage of length 10 m, heigth1.5 m and go out in the grotto Bottom of Sea (length and width 15 m, height 4 m). The sponge texture of walls of grotto with great number cavities very differs from surface of walls in the other parts of cave. This could be explained by operation of condensed water.

The air of inside warm part of the cave, with high humidity, is cooling down on the boundary of temperatures, it makes one oversaturated and surplus moisture is condensed on the walls. The condensed water is an aggressive one and easily dissolves gypsum and, as a result, great number cavities are appeared on the walls and ceiling.

The similar sponge surface of walls might to be seen in the room Coralls (length 93, width 43, height 3, distance from entrance 400 m). In 1770 year in the cave was described the maximal spreading of ice deposits here had been the constant ice formations and they extended much more deeply into the cave.

Researching the peculiarity of texture of walls in the gypsum cave we can to try to know about boundaries of icing in different periods of cave's history.

ICE CAVES OF PERM REGION.

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Approximately amount of the caves in Ural exceeds 2000 and about 700 of them are situated in Perm region. Of course, except Kungur Ice cave there are much outstanding caves with constant ice forms in our region. Caves occur both as in sulphate as in carbonate rocks. The most representative among ice caves (except Kungur Ice cave) are next ones:

Kichmenskaya cave is situated in Kungur district on the right side of Kichmen river in 3.5 km from river outlet, next to Smolino village. This cave belongs to the Sylva-Serga karst area, where is developed gypsum and anhydrites of Iren suit. Cave looks like labyrinth which consists from numerous rooms and passages of total length 470 m. In the pre-entrance rooms constant ice forms exist.

Varsanofievoy cave is situated in 4 km. to the west from Mazuevka vlg. and belongs to west part of Mazuevo karst depression. Entrance to the cave is in the karst doline named "Volch'ya yama" (wolf trap). Varsanofievoy cave is appeared on the contact of limestone and dolomites of philippovka horizon and gypsum and anhydrite of Popovka suit of Kungur geologic stage (Kishert karst area).

Uinskaya ice cave is situated on right side of Aspa river in 4 km. from Uinskoe settlement. It occurs in gypsum of Lunejki formation of Iren horizon of Kungur geologic stage (Iren speleological district) which is underlayered by waterproof limestone of Tuya formation. In the pre-entrance part are exist constant glaciations.

Eranka cave is the biggest and the most beautiful cave among others in the basin of Beresovaya river. Length of the cave exceeds 500 m. and depth - 50 m. The cave is richly decorated with speleothems - as calcite as ice ones. Big glacier of 10 meters width slowly descends in two pre-entrance rooms of the cave.

Medeo cave occurs in the silicificated limestone of Sakmar geological stage of bottom Perm. Cave's entrance opens in slope in 150 meters higher Badya river's bed in the doline in the bottom of 15-meter stone wall. Abrupt descending rubble debris stream leads into the sole room by length 60 meters. Shape of the cave looks like bag with bottom is covered by layer of ice.

Holodnaya cave. Entrance of the cave is situated on level 130 meters higher of level of water of Beryozovaya river. The cave occurs in thin-layered limestone of Sakmar geological stage of bottom Perm. Total length of the cave is 50 meters and depth – 22 meters. Shape of the cave looks like bag with bottom is covered by layer of ice.

Mariinskaya cave is situated in settlement Verhnaya Gubaha. The cave has two entrances and occurs in limestone of bottom carbon. Length of explored part of the cave is 1000 m. length of constant glacier is 60 m.

Ice cave (territory of reservation "Sukhoy log"). Cave has two entrances; the first one is the narrow passage with ice floor. Second entrance is situated in 6 meters over first one in the bottom of stone wall in cone-shaped doline. The cave occurs in light-grey limestone of Visey geologic stage and belongs to Kizel-Yayva speleological district. Inside we can find one big room with floor covered by ice which has thickness up to 6 meters. Length of the cave is 85 meters, depth - 16 m.

KUNGUR ICE CAVE AND ICE MOUNTAIN AS A NOMINATED OBJECT TO INCLUSION IN UNESCO'S WORLD HERITAGE LIST.

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Kungur Ice cave is sole excursion object among gypsum caves with constant ice deposits in the world. Ice mountain and Kungur Ice cave are the unique striking example of classic surface and underground carbonate-sulphate karst. Kungur Ice cave is unique because of conditions of its occurrence in the carbonate-sulphate deposits of bottom layer of Perm. The cave has a number of unique characteristics which differs it among gypsum caves of the world.
Total area of object of nomination to the list of World heritage of UNESCO is 106 ha. Maximal width is 1.9 km. to south-east direction and 0.9 km - to north-east. Total length of the cave is 5700 meters, total area - 65000 sq.m. At all, on the area of nominated territory exists two caves.

The importance of the object:

- Kungur Ice cave is one of the longest and has the most volume among gypsum caves of Russia.
- Conditions of formation of a cave define its specific water regime - there are more than 70 underground lakes of different sizes and conditions of charging in the cave
- There has been noted out standard for such objects "system of furnace air draught" which is defines the climatic features in Kungur Ice cave. Uniqueness of microclimate of the cave is proving the presence of the full set of microclimate zones what is very rare for the caves, especially gypsum ones.

- There are exists constant ice forms next to the cave's entrance (absolute high is 120 m. above sea level, that is the lowest point out of territory of zone of permafrost).
- The territory of nominated object is inhabited by rear and threatened species of plants and animals. They are an important world heritage and plays a big role in preservation of biodiversity of region.

The territory of Ice mountain and Kungur Ice cave is the area without harmful anthropogenic activity. Constant ice inside the cave and karst processes play a big role in evolution of underground and surface (terrestrial) geo- and ecosystems (especially on geological, hydrological and geomorphic processes, structure of species of fauna and flora). Lakes of the cave are inhabited by local specie of amphipod - *Crangonyx chlebnicovi ssp*. *Maximovitchi.*

Object (Kungur Ice cave and Ice mountain) meets all criteria of Convention Concerning the Protection of the World Cultural and Natural Heritage:

1. Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
2. Be outstanding examples representing major stages of the earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.
3. Be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.
4. Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including habitats containing threatened species of universal value from the point of view of science or conservation.

It also meets the requirement of integrity and fully meets definitions of nature heritage described in convention.

COMPOSITION OF ICE FORMATIONS OF ORDA CAVE.

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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. In 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 meters 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 Ledyanopecsherskaya geological formation. Ledyanopecsherskaya 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 gr/l) and sulphate-ion (1.2-1.3 gr/l) and mineralization approximately 2 gr/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.

THE MAIN RESULTS OF STUDYING OF AMPHIPODS CRANGONYX CHLEBNIKOVI IN THE UNDERGROUND WATER OF KUNGUR DISTRICT.

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Troglobiont amphipods *Crangonyx chlebnikovi* Borutzky,1928 is one of the most exotic species of animals in Kungur district. These amphipods were opened by biologist E.V.Borutzsky in 1926 in the lakes of Bolshaya Mechkinskaya cave and described by him as a new species. This species has been named in honour of first guide of Kungur Ice cave - A.T. Chlebnikov. Now *Crangonyx chlebnikovi* are known in Kungur Ice, Ordinskaya and Babinogorskaya caves, source Shaharovskiy on Irgina river and in one of the wells in Bryohovo vlg. of Suksun district, that is known natural habitat of this species is not go beyond of boundaries of Kungur, Orda and Suksun districts of Perm region. Total amount of findings of *Crangonyx chlebnikovi* lets to clime that this amphipods has very narrow natural habitat which is not goes beyond of areas of Iren and Nizhnesylvinsk areas of carbonate-gypsum karst. *C. Chlebnikovi* is outstanding species among modern hydrofauna of Ural which is characterized by wide natural habitat and very low specificity.

Crangonyx chlebnikovi Borutzky is one of members of wide group of amphipods *Synurella-Crangonyx* which inhabits the underground sources. Russian scientists traditionally estimate this group as a part of Gammaridae family, but foreign systematics give it higher status - Crangonyctidae family or even Crangonyctoidea superfamily. From all cave's fauna of Kungur district only amphipods *C. Chlebnikovi* are specialized troglobionts. These amphipods haven't eyes and cuticular pigments and are looked white because the colorless fibers are seen through transparent coverlet. Outstanding shape and exotic mode of living of troglobionts always attracts attention of scientists. *Crangonyx chlebnikovi* isn't exclusion. In last years this species is object of scrupulous researching from different points of view - systematics, morphology, ecology. There is described the new subspecies - *C. chlebnikovi maximovitshi* Pan'kov, Pan'kova, 2004 in Kungur Ice cave. Now we can tell about necessity of extraction of *Crangonyx chlebnikovi* together with *Crangonyx arsenjevi* (Derzhavin, 1927) into separate genus for which the specialists already offered the scientific name "*Amurocrangonyx*".

Now we have data about spatial distribution and relative amount of population of *C. Chlebnikovi* in the lakes of Kungur Ice cave and about other parameters: sizes and age structure, proportion of genders, prolificacy, fertility, mortality, properties of life's cycle (length of separate stages of ontogenesis and periods of reproduction), speed of growth and production characteristics.

The question about origin of *C. Chlebnikovi* and time of colonisation by them of underground water of Kungur district is also very interesting. It's considered that navy ancestors of *C. Chlebnikovi* started colonisation of continental water sources in Mesozoic period. This fact explains the modern spreading of *Synurella-Crangonyx* group, isolated fragments of natural habitat of one could be met everywhere in the world. These amphipods are known in Holarctic, India, South Africa, Madagascar, New Zealand, Australia. *Crangonyx* s. lat. genus containments by Holarctic area that means his age is Paleogenic. *Crangonyxes* inhabit the underground and sometimes surface water of West Europe, North Africa, Pre-Ural, Central Asia, South Far-East, North America. Their modern natural habitats are relict ones and often coincide with areas of conservations of tertiary fauna and flora what fact indicates the age of genus. Colonisation by *Crangonyx chlebnikovi* of the caves of Kungur district took place, to all appearance, in first phase of early Pleistocene when glaciers has stimulated populating of the underground cavities.

FEATURES OF APPEARING OF CONSTANT ICE FORMATIONS IN ORDINSKAYA CAVE.

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The conditions of appearance and development of ice formations in the caves are closely connected with cave's microclimate. Natural or artificial change of morphology of the cave, of configuration of rooms, passages or entrance leads to change of microclimate of the cave.
Ordinskaya cave is longest underwater cave of Russia and longest underwater gypsum cave of the world. Length of underwater part is more than 4.2 km and dry one - 300 meters. Approximately all volume of water in the cave exceeds 200000 m^3. So, except factors, which were mentioned above, big volume of water also influence on formation of microclimate of the cave.
During last years the second entrance of the cave has appeared by natural way and one of the outputs was filled up by clay filler with rubble. It has resulted by appearance on the bottom of first room of the cave constant ice formations - ice sublimation crystals, ice stalactites and ice bark. Observations which conducted during last 3-th years has shown the changes of some of characteristics of microclimate and enlarging of amount of constant ice formations in the Ordinskaya cave.

INFLUENCE OF RADON ON INHABITANTS OF KUNGUR ICE CAVE AND PERSONNEL.

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Not so long ago it is established that those miners who is working in mines with greater concentration of radon suffer from cancer of lungs more frequently. From this fact there was made conclusion about cancerogenic influence of inhalation of radon and affiliated products of disintegration of radon (APD). As a result, in many countries have been adopted programs of inspection of houses and industrial buildings, but direct connection between concentration of radon and rise of amount of events of cancer of lungs has not been revealed. We think this result is quite natural because there are many additional reasons, closely connected with forming of doze press onto human's organism from radon and APD and forming of adaptive reaction from organism, which are being for a long time under action of radiation. Analyses of action of radon, which is inert radioactive gas, has shown that at receipt together with air into the lungs it very soon is soaked up by blood and spreads over all organism. Therefore radon irradiates all the cells in the body. Dose of radioactive irradiation of lungs and other organs is approximately equivalent. In the same time, disintegration of APD is forming dose of radioactive irradiation only on the lungs. If radioactive equilibrium is exists, dose from APD acting on lungs, at our calculations, 100 times higher, than these organs get from radon. Because ventilating of mines is significantly worse, than ventilating of buildings on the surface, therefore in the firsts the degree of equilibrium between radon and APD is significantly higher. Therefore, doses from APD, acting at lungs of miners, are significantly large, than ones acting at people which are working on the surface. Additional cancerogenic factor is big amount of dust in the air of the mines. The second important factor is periodicity of work. Constant acting of radioactive irradiation can lead to physiological adaptation of organism. We proved that inhabitation of mice in the conditions with constant radioactivity leads to lowering of intensiveness of metabolism of animals. Decreasing of consumption of oxygen makes animals less sensitive to radioactivity and lets the population successfully live in the environment with high level of radioactivity. Physiological adaptation of mice to γ-radiation formed for 3-4 days. If animals eat the radioactive food, then adaptation takes more time - approximately half of year. Therefore if animals inhabit areas with higher level of radioactivity then after some period of time they become less sensitive to harmful influence of radioactivity. The same processes are characteristic and for people too. More detailed researches of people who lives and works in constant radioactive environment will let give us more precise answer about influence of radon on human's organism.

THE MICROCLIMATE OF THE CAVES AND DEVELOPMENT OF ICE DEPOSITS IN THE CAVES OF EUROPEAN PART OF NORTH OF RUSSIA AS INDICATOR OF CHANGE OF CLIMATE.

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Features of development of ice deposits in the caves at the North of Russia are connected with change of climate of modern period. Practically everywhere is seen the reduction of amount of constant ice in the caves and seasonal ones are partially melting during thawing periods in winter and rises of underground water. Changes are caused by outside factors: temperature of the air, balance, speed and temperature of waters penetrating into karst rocks. At the same time average changes of important parameters for dynamics of microclimate of the caves are very low. Rise of temperature of outside air from 2000 through 2007 was 0,1°C (from 0,2 up to 0,3°C) and average amount of precipitation has reduced from 582.8 down to 566.8 mm. The deciding role has connection from abnormal climatic factors: storm rains, out-of-seasonal snowfalls, fast cold snaps in periods of high water.

The ice deposits of North Russia are presented by ice of all genetic classes which are very various at their morphology. Features of spatial distribution of ice of the caves connected with morphology, aerodynamics and hydrodynamics of the cavities. There are 3 cycles of development of seasonal ice.

1. Pre-winter cycle. This one is characterized by development of ice crystals, stalactites, stalagmites and stalagnates, ice barks and surface ice on lakes and rivers.
2. Pre-spring cycle. This one is characterized by development of ice in the inclined descending entrances of the caves and pre-entrance areas, enlarging of ice crystals.
3. Summer cycle. Development of constitutional ice deposits during freezing of moisture friable deposits.

The main volumes of constant underground ice are formed in the pre-entrance area of the cave in zones of negative temperature with length up to 100-200 meters.

Duration of monitoring of temperature in the caves of south-east part of Belomoro-Kuloyskogo plateau is different - from 12 to 23 years. The main features of microclimate of the caves of European North of Russia (ENR) are next ones: the low average temperature of air, the high moisture and the low speed of moving of the air streams.

Analyses of data of monitoring has shown common tendency to the lowering of temperature of the air because of lowering of one in summer time. Important, what winter temperatures are as a rule constant ones. These features was noticed in most of the caves, where monitoring was conducted. The difference between average year temperature in the different cave and outside ones enlarges up to 0.3-2°C. Amplitudes of difference of maximal and minimal temperatures of air for different parts of the caves has increased from 2000 up to 0.5-8°C. The average urgent temperatures for zones with constant icing has lowered down to 0.3-2.3°C and has increased up to 0-0.2°C for zones with seasonal icing. There are present stable trends to lowering of maximal and minimal temperatures of zones with constant icing and their stability and small enlarging temperatures for the caves or parts with seasonal ice. Nevertheless, because of short-term rise of temperature during high rain water in the caves is noticed melting of constant underground ice.

Today in ENR goes on lowering the ice masses of constant ice deposits in comparison with period before 90-th of last century. There were noticed long-term cycles which have a feedback with a cycle of solar activity. The factors of influencing onto ice deposits in long-term cycle are the same ones that in year cycle - the temperature, aerodynamics and hydrodynamics. The stable enlarging of ice masses in this century has been noticed only in the cave "Ledyanaya Volna" because ice deposits and water flow are exist in different levels of the cave. In 2004 entrance to the cave was closed by landslide.

The changes of microclimate of the caves and dynamics of cave's ice are, at all, the clear indicators of trend of modern climate change.

INTERMEDIATE RESULTS OF MONITORING OF RADIATION IN KUNGUR ICE CAVE.

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The First researches inside karst cavities, which are using as objects of tourist activity have been done in middle of 90-th of last century. These researches have shown the possibility of accumulation of significant concentration of radioactive radon in cave's air even if surrounding rocks contain "less than clark" concentrations of radioactive elements.

As has been shown by pilot researches in 1999-2000 and regular radon monitoring 2006-2007 for Kungur Ice cave are characteristic the next changes of conditions of radon concentration in the cave's air :

Rather low concentration of radon and his affiliated products of disintegration in the cold time of the year with constant negative temperatures of outside air. Volumetric activity of radon and his affiliated products Po-218 (RaA) is less than 400 Bc/m^3. It is hundredfold exceeds the concentration of radon in outside air and comparable with concentration of radon in the cellars and first floor of the buildings.

At long thawing weather (2-3 days of positive temperature) there was fixed increasing of concentration of radon in 2-2.5 times in the cave.

In inter-season periods (April, October, partially November and March) the volumetric activity of radon exceeds 2000 Bc/m^3 in all rooms of the cave except of intensively ventilated ones.

After an establishment of "summer" direction of moving of the air inside of the cave (from deep part to the entrance) the concentration of radon is increasing up to 7000-9000 Bc/m^3. Sometimes in the some points of observation have been registered values more than 11000 Bc/m^3. The absolute maximums of instant values of volumetric activity for Po-218 (RaA) are 13200 Bc/m^3 and daily-average values for radon - 12100 Bc/m^3. Should be said that if values of volumetric activity of radon and affiliated products are so high, then γ-background of radiation is defined mostly not by rocks which contained the cave but by radioactive aerosols. In particular, those part of ones that have condensed onto sensors of radiometers during of measurement.

From the point of view of dosimetry the most important parameter is the volumetric activity of short-living affiliated products of radon condensed at aerosols. At all their concentration and degree of power influence is estimated by value of equivalent equilibrium volumetric activity (EEVA). Absolute maximum of instant value of EEVA which has been fixed in Kungur Ice cave – 8000 Bc/m^3 (error of single measurement isn't exceeded ±30%). For estimation of doze of radiation for personnel of the cave (if

they will work without any respirators in period from April to October) after monitoring there was recommended average amount of EEVA ≈ 2700 Bc/m^3.
There isn't quite clear today as different factors (seismic events, fast change of level of aquifer in periods of high water, amount of dust in the cave's air and so on) influencing onto possible change of radioactive state inside of Kungur Ice cave. Therefore the radon monitoring should be continued.

ICE CAVES OF IRKUTSK AMPHITHEATRE – OBJECTS OF NATUREL HERITAGE

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Three ice caves – objects of natural heritage are distinguished in Irkutsk amthitheatre: Argaracan, Bolchaya Baidinskaya and Urungaiskaya. The annual and perennial ice formations of different genesis: congelation ice, sublimated ice, as well as deposited and metamorphosed ice are wide spread in caves. Glaciers in underground cavities are absents, there are aufeises only.
Cave Argaracan is situated at the upper part of river valley of Lena. It is one of the largest caves in the Region: the length is more than 5 km, the depth is 52 m. The presence of the aufeis with area approximately 35 m^2 and thickness up to 2-2,2 m is noted in this cavity. Its formation due to existence of two entrances, placed in 5 m one from another, in specific siberian conditions. Unique ice crystals are observed on the ceilings and the walls above and near the aufeis.
Small cave of western shore of Lake Bakal - Bolchaya Baidinskaya (the length is 45 and the depth is 11 m) is known by a big aufeis (the thickness is more than 8 m). The remains of malacofauna, revealed in the lower part of aufeis, witness to the ice's formation in the Pleistocene-Holocene. In 1995 the points of observations under cave ice were organized in this caverne: in average, an intensity of the melting of ice is reaching of 12 cm per year.
Cave Urungaiskaya (the length is 780 and the depth is 28 m), situated at the mountains of Eastern Sayan, is characterised by the ample aufeis with the area exceeding 650 m^2, its thickness varies from 2 up 4-4,5 m. A lot of exotic ice formations, named, par exemple, "Besedka Snezhnoi korolevi" –

"Summer-house of Snow queen", "Blisnetsi" - "The twins", etc., are marked on the walls and ceilings of the cavity.

All caves considered have the scientific, environmental and aesthetic value and there are the objects of Naturel heritage of Irkutsk amphitheatre.

CYANOBACTERIAL-ALGAL COENOSISES OF KUNGUR ICE CAVE

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Caves are specific ecosystems with unique biota, including cyanobacterial-algal coenosises (CAC) (Coute, Chauveau, 1994). The aim of this investigation was to supply data about taxonomic composition of CAC and to analyse their distribution in Kungur Ice cave depending on degree of illumination.

Kungur Ice cave is situated on the right riverside of Syilva river at Kungur town north-east outskirts (Perm region). The cavern lies in the gypsum, anhydrides, dolomites and limestones; its length is 5,7 km. There are 70 lakes in the cave, air temperature changes from -3,7 to +5,0ºC. There is tourist route with artificial illumination in the cavern (Дублянский, Кадебская, 2003). On 22-23 June 2007 forty samples were collected from the tourist route of the cave. Samples were taken from cave floor deposits, lake-beds, cave waters and cave walls by standard methods. Thirteen samples does not contain cyanobacteriae and algae. The species composition of CAC was revealed by standard methods. The comparative floristic methods were used for investigation of CAC structural-functional organisation (Кузяхметов, Дубовик, 2001).

There were founded 25 species and infraspecific taxa of cyanobacteriae and algae: Cyanoprokaryota – 11 species and infraspecific taxa (44,0 %), Bacillariophyta – 7 species and infraspecific taxa (28,0 %), Chlorophyta – 7 species and infraspecific taxa (28,0 %). Oscillatoriales (24,0 %), Nostocales (16,0 %) and Chlorococcales (16,0 %) were most rich in species from 10 orders. Pseudanabaenaceae (12,0 %), Nostocaceae (12,0 %), Phormidiaceae (8,0 %), Naviculaceae (8,0 %), Bacillariaceae (8,0 %), Chlorellaceae (8,0 %) and Chlorosarcinaceae (8,0 %) dominated from 16 families. Leptolyngbya (8,0 %), Nostoc (8,0 %), Navicula (8,0 %) were most rich in species from 22 genera. Muriella magna Fritsch et John, Leptolyngbya gracillimum (Zopf.) Anagn. et Kom., Mychonastes homosphaera (Skuja) Kalina et Punč., Calothrix elenkinii Kossinsk., Leptolyngbya boryanum (Gom.) Anagn. et Kom., Amphora montana Krasske, Nostoc punctiforme f. populorum (Geitl.) Hollerb. dominated on sum of abundance marks. Muriella magna Fritsch et John (F = 30,0 %), Leptolyngbya gracillimum (Zopf.) Anagn. et Kom. (F = 22,5 %), Leptolyngbya boryanum (Gom.) Anagn. et Kom. (F = 20,0 %), Amphora montana Krasske (F = 20,0 %), Mychonastes homosphaera (Skuja) Kalina et Punč. (F = 20,0 %) were the species most commonly revealed. The life-form spectrum: Ch5P4hydr.4B4CF2C2PF1M1H1.

There were founded 19 species and infraspecific taxa of cyanobacteriae and algae at illumination zone (average species number in sample – 2,2): Cyanoprokaryota – 8 species and infraspecific taxa (42,1 %), Bacillariophyta – 6 species (31,6 %), Chlorophyta – 5 species (26,3 %), belonging to 9 orders, 14 families and 16 genera. There were revealed 18 species and infraspecific taxa of cyanobacteriae and algae at dark zone (average species number in sample – 2,7): Cyanoprokaryota – 9 species and infraspecific taxa (50,0 %), Bacillariophyta – 4 species (22,2 %), Chlorophyta – 5 species (27,8 %), from 7 orders, 11 families and 15 genera. In the result of comparative floristic analysis on qualitative Serensen-Chekanovskiy Resemblance Coefficient were founded, that CAC species compositions of illuminative and dark zones have got high resemblance (64,9 %).

Thus, taxonomic composition of CAC was investigated in Kungur Ice cave, cyanobacteriae were dominated. It was revealed, that average species number in sample at illuminate zone higher, than at dark zone, although CAC species compositions of these zones have got high resemblance.

THE MICROBIAL COMMUNITIES OF MIDDLE SIBERIAN COLD CAVES

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Nine years research in 16 cold (temperature 0 .. +5ºC, relative humidity 80 – 100%) limestone caves of Middle Siberia revealed the presence of specific communities of fungi and bacteria. Despite oligotrophic conditions the indigenous cave microbiota is relatively abundant and diverse, both systematically and ecologically. The total number of fungi vary from less then 103 colony forming units (CFU) per gram of cave sediments in low impact caves and cave sites to 3,6x106 CFU g-1 in high impact areas such as underground camp sites. No fungi were found in previously non-visited cave sites. The taxonomic diversity of cave fungi is similar to those of soil fungi with the predominant isolates belonging to genuses Penicillium (34,5%), Chrysosporium (21%) and Mucor (20%). Members of the genera Pythium, Mortierella, Thamnidium, Paecilomyces, Cryptococcus, Rhodotorula, Fusarium, Verticillium, Periconia, Thrihoderma, Doratomyces, Echinobotryum were also found. In presence of organic matter the fungi persist as mycelium or visible sporulating colonies up to 50 cm in diameter. In low organic sediments fungi persist as conidia (spores). The total number of cultivated bacteria vary from 104 to 107 CFU g-1 of cave sediments, and from 102 to 105 CFU ml-1 of water. The most abundant and diverse bacterial biota is present in high human impact areas where number of bacteria (up to 5,75x107 CFU g-1) is comparable with those in soil. In contrast with fungi, high numbers of cultivated bacteria (up to 105-106 CFU g-1) are found in low human impact areas including previously non-visited cave sites. Cave bacteria are metabolic active with minimal observed in situ generation time 48-72 hours. Both oligotrophic and eutrophic bacteria were found in cave sediments and in water samples, with the ratio of obligate oligotrophs to total heterotrophs ranged from 6,8 to 94,5%. Among predominant isolates of eutrophic bacteria members of the genera Pseudomonas, Arthrobacter and Bacillus have been identified. In water sources near underground camps Escherichia coli was found in numbers up to 4,8x103 CFU ml-1. All the isolates of cave fungi and bacteria are able to grow at low temperature (+4ºC). Optimum growth temperatures range between 5-15ºC and 30-35ºC. The relative numbers of psychrophilic, psychrotolerant and mesophilic forms vary significantly between individual caves and between sites within the cave. Maximal numbers of psychrophiles (up to 91% of total number of cultivated bacteria and 33% of fungi) are in low-impact caves or cave sites with long-term income of organic matter. Math modeling of evolutional adaptation of microbial communities to the low-temperature cave environment showed that stable cave microbial community should consist of only psychrophilic

(autochtone) and mesophilic (allochtone) forms with predominating of the psychrophiles. The presence of psychrotolerant forms means that formation of cave microbial community is still in progress. Both bacteria and fungi form the first trophic level in Siberian cave ecosystems and provide the food source for cave invertebrata.

POSTER PRESENTATIONS

PALEOENVIRONMENTAL RECORDS FROM ICE CAVES OF VELEBIT MOUNTAINS - ICE PIT IN LOMSKA DULIBA AND VUKUŠIĆ SNOWCAVE, CROATIA: AIMS AND SCOPE OF A CROATIAN-HUNGARIAN PROJECT

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Ice pit in Lomska duliba (Ledena jama u Lomskoj dulibi) and Vukušić Snowcave (Vukušić snježnica) are located in the northern part of the Velebit Mts. in Croatia. Geomorphologic researches have shown that the Pleistocene glaciation spread over a large part of the northern, central and southern Velebit, the mountain that spread of NW-SE direction along the Adriatic coast.. In that process, various types of glaciers were differentiated, and morphologic proofs (denudation and accumulation) of their expansion were found.

Entrance of Ledena jama (44.74N, 15.03E 1235 m asl) is situated in Lomska duliba glacier valley so genesis and morphology of the cave is closely connected with spreading and dynamics of Lomska duliba glacier. Ledena jama is a knee-shaped, 536 m deep karst pit. One part of the entrance of the pit preserves a vast ice block. It spreads from -50 m depth to -90 m depth, and takes 20-30 m in diameter. During the speleological and morphological explorations of the pit, some analysis of cave ice, wood branch from ice and speleothems also were done. The estimated age of ice deposit based on tritium (^{3}H) activity in ice and radiocarbon (^{14}C) dating of wood branch in the ice was cca 500 years. In addition, the age of flowstone (from -60 m depth) dated by the $^{230}Th/^{234}U$ method was estimated to be 300 000 years. Stable isotopic data of cave ice samples collected from different depth alongside the ice profile range from -6.74‰ to -10.25‰ and from -50.3‰ to -67.9‰ (vs. VSMOW), for $\delta\ ^{18}O$ and δ D, respectively. These values agree reasonably well with the average annual stable isotopic composition of the local precipitation (Zavižan 44.82N, 14.98E, 1594 m asl.) collected over the period September 2000 – December 2002. Vukušić sniježnica (44.8N, 14.98E 1490 m asl) is located near the Zavižan Peak. Thickness of its ice deposit is estimated to be more than 10 m. Morphological evidences and archive data from previous surveys (1977, 1992) suggest that both ice blocks have shrunken during the past decades. To scrutinize and quantify the present dynamics of cave ice we have installed scales into the surface of the ice block. In addition, plastic nets are placed on the ice surfaces in both caves serving as artificial reference horizons in future monitoring.

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