

DOBRICH
Bulgaria



HYPOGEA

3rd International Congress of Speleology in Artificial Cavities 2019



PROCEEDINGS OF INTERNATIONAL CONGRESS OF SPELEOLOGY IN ARTIFICIAL CAVITIES

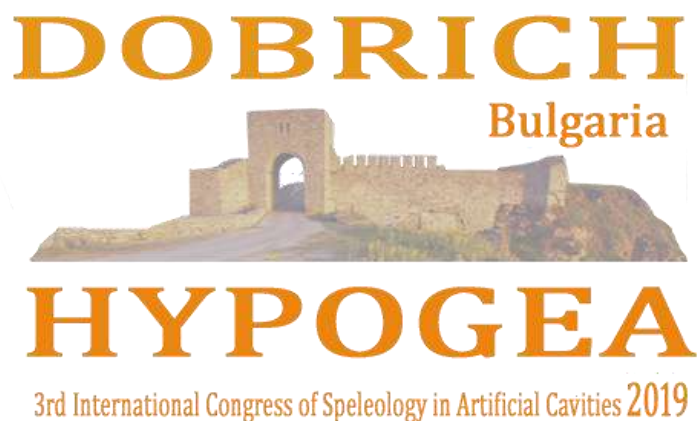
DOBRICH - BULGARIA - MAY 20-25 2019



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HYPOGEA2019

Dobrich, Bulgaria, 20-25 May 2019



Proceedings of International Congress of Speleology in Artificial Caves

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Dobrich , Bulgaria , 20/25 May 2019

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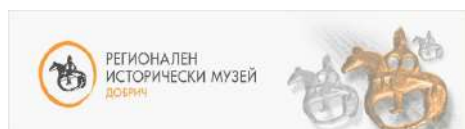


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The Rock-hewn Churches of Ivanovo are a group of monolithic churches, chapels and monasteries hewn out of solid rock and completely different from other monastery complexes in Bulgaria, located near the village of Ivanovo, 20 km south of Rousse The monastery complex owes much of its fame to 13th- and 14th century frescoes, preserved in 5 of the churches, which are thought of as wonderful examples of Bulgarian mediaeval art . UNESCO World Heritage Site .



**GEOLOGY, GEOMORPHOLOGY,
ENVIRONMENTAL HAZARDS**

NATURAL RADIOACTIVITY IN SOME CAVES OF THE VAYOTS DZOR PROVINCE, ARMENIA

Dmitry Albov^{1,2}, Boris Gasparyan³

¹*Lomonosov Moscow State University, Chemistry Department, Leninskiye Gory 1-3, Moscow, 119991 Russia*

²*Czech Speleological Society ZO 3-05, Vítězná 414/72, Karlovy Vary, 36009 Czech Republic, dmitryalbov@gmail.com*

³*Institute of Archaeology and Ethnography, Charents st. 15, Yerevan, 0025 Armenia, borisg@virtualarmenia.am*

Abstract

During the international expedition in Armenia in 2017 levels of gamma radiation were measured in four caves in Vayots Dzor province. Background radiation levels in the Archeri, Mozrov and Magel caves show no difference with the medium level in the district, but in one hall of the Areni-1 cave gamma radiation level is up to 3 times higher. This hall contains archaeological layers with the cultural material of Chalcolithic period. The results of gamma spectral measurements of samples from this cave are presented in this article.

Keywords

Radioactivity, gamma radiation, archaeology, cave

To find a suitable location for radon monitoring, levels of gamma radiation were measured in four caves in the area of Noravank monastery, Vayots Dzor province, Armenia. Radon is known as an important earthquake predictor (Riggio & Santulin, 2015), its isotopes are formed by the radioactive decay of the uranium and thorium traces in the most rocks. Radon is released during rock fracture and can be easily detected due to its radioactivity. Its very short half-life makes radon levels sensitive to short-term geological processes. Radon concentrates in underground structures such as natural and artificial caves, mines and cellars. Radon is a pure alpha emitter, but its daughter isotopes yield strong gamma radiation, so there is a reasonable correlation between radon concentration and gamma radiation level suitable for a preliminary search of radon.

Measurements were carried out in the caves Archeri, Mozrov, Magel and Areni-1 using a SRP-68 scintillating exploration radiometer. Background radiation levels in three of them show no difference with the medium level in the district, they are in the range of 7-11 $\mu\text{R/h}$. An interesting anomaly was found on the floor in one of the galleries of the Areni-1 cave, where gamma radiation level reached 21 $\mu\text{R/h}$, up to 3 times exceeding levels on the surface and in other caves. However, this cave is perfectly ventilated through several entrances, so radon hardly concentrates there and we could suppose that it should not be the main reason of radiation.

The Areni-1 cave is a noticeable archaeological site, it is situated at 1 km from the Areni village on a bank of the Arpa river. Archaeological excavations were carried out from 2007 to 2014. Several strata were found dating since the Late Chalcolithic to Medieval time. Excavations showed that different parts of the cave were used by inhabitants for different purposes such as storage, living and ritual purposes. Soil in the cave consists of sand-rich silts of unknown genesis, probably by weathering of the

cave enclosing rock and cultural activities took place inside of the cave.

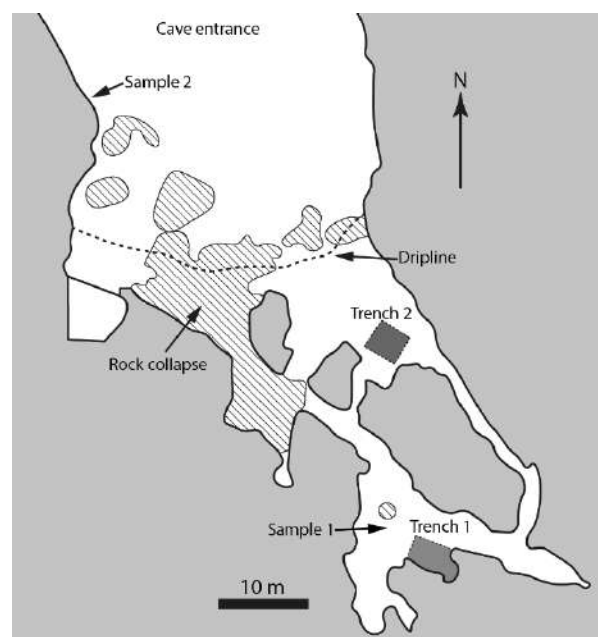


Figure 1. Plan of Areni-1.

In the remote hall (Fig. 1) the Trench 1 was excavated, revealing four archaeological layers of late Chalcolithic period with thickness of 4.5 m (units 1002-1005, Wilkinson et al., 2012). Unit 1005 contained scattered ceramics and animal bones (mainly of sheeps and goats). Units 1003 and 1004 contained whole ceramic vessels, pottery fragments, animal bones and obsidian artefacts. Two of the pots contained sub-adult human crania and an adult femoral shaft. Six large ceramic storage vessels contained plant remains and were set within clay basins, which in turn formed part of a more extensive baked clay surface. A ^{14}C date on charcoal from Unit 1004 suggests that deposition occurred around 4230–3970 Cal B.C.

In the entrance of the cave the Trench 2 was excavated. Several units of the Chalcolithic period also contained crania in ceramic vessels, storage vessels, bones of animals and remains of plants. Units in the Trench 2 containing storage and ritual vessels dated by 3970-3800 B.C. are contemporary with the units 1002 and 1003 in the Trench 1.

Unusual gamma radiation level was found only in the Trench 1 and at the soil surface around it (Fig. 1). The Trench 2 shows no radiation anomaly as well as the rest of the cave.

Table 1. Activities of major nuclides.

Nuclide	Decay chain	Sample 1 Bq/kg	Sample 2 Bq/kg
^{235}U	^{235}U	0.82	0.66
^{211}Bi	^{235}U	36.11	32.43
^{238}U (calculated)	^{238}U	17.51	14.19
^{234}Th	^{238}U	11.12	10.40
^{214}Pb	^{238}U	13.47	12.83
^{214}Bi	^{238}U	12.30	11.54
^{232}Th (calculated)	^{232}Th	33.66	2.30
^{228}Th	^{232}Th	77.41	5.30
^{228}Ac	^{232}Th	12.87	0.91
^{212}Pb	^{232}Th	14.91	1.05

Activities of nuclides belonging to the ^{235}U and ^{238}U decay chains are a little bit more in the sample 1. However, activities of nuclides belonging to the ^{232}Th decay chain is about 14 times higher in the sample 1.

We assume that higher content of thorium and its daughter isotopes is a result of human activity in the Areni-1 cave. For example, thorium may present in a peculiar type of pottery made from thorium-rich clay. Also the source of thorium could be bones of animals and humans who lived in the area with high thorium content. Also we can not exclude the role of geological processes in thorium accumulation. In order to locate thorium containing material it might be possible to use alpha radiation meter in the cave and namely in the Trench 1, followed by gamma spectrometry of some artefacts.

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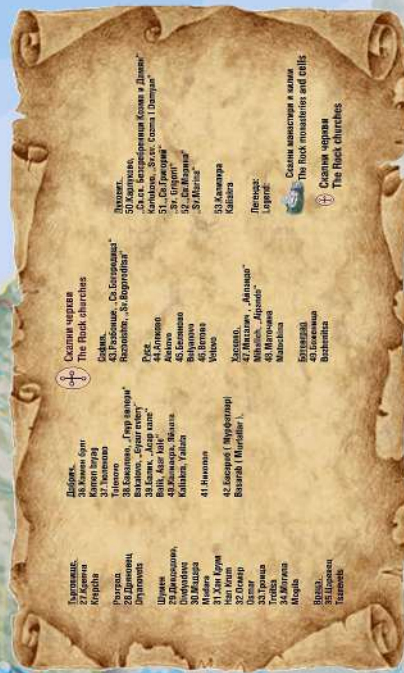
PRELIMINARY PROGRAM OF THE CONGRESS - OVERVIEW

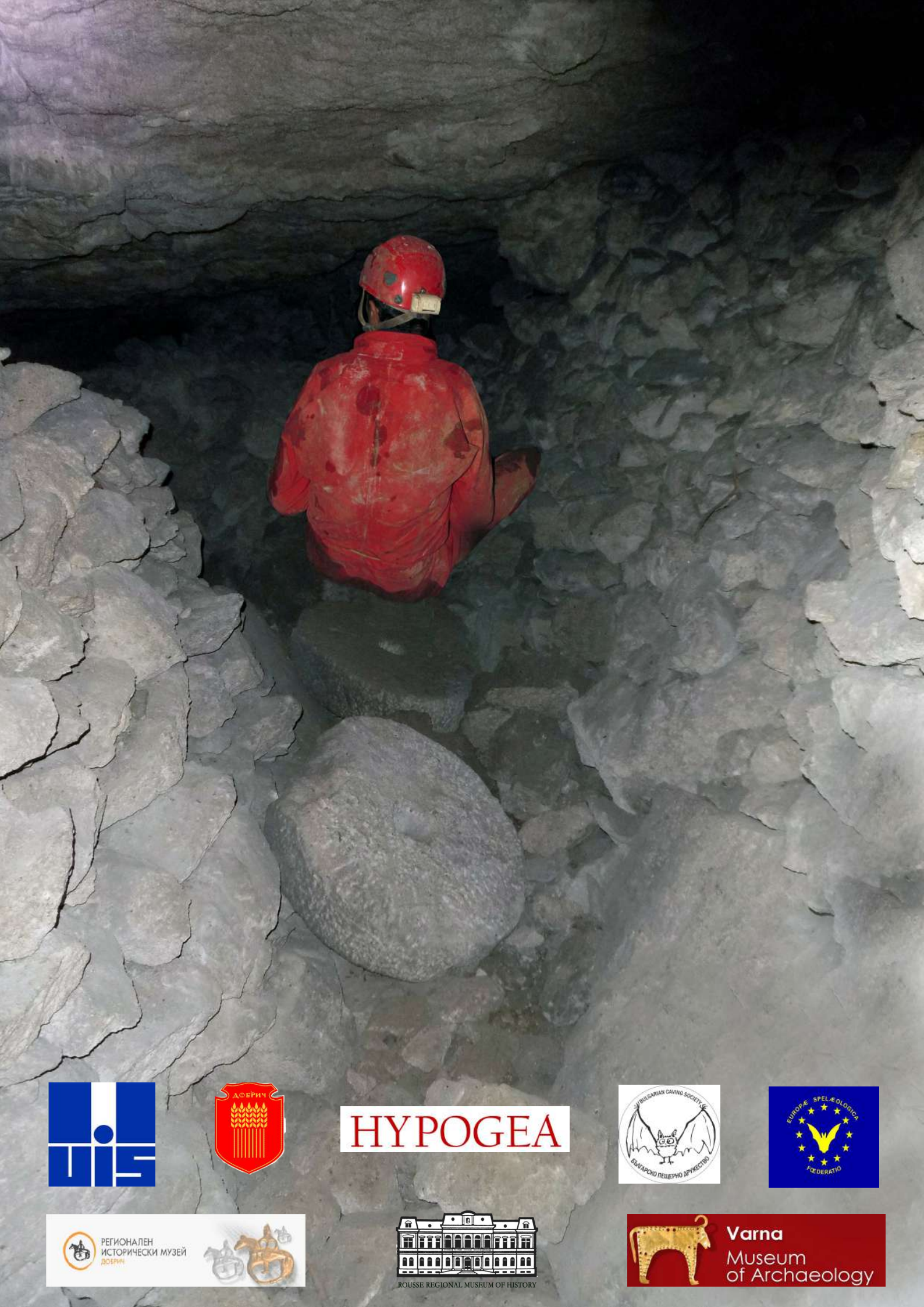
Time	Monday 20 th May
9:00	Opening Congress Office
10:00 – 14:00	General Registration (Congress Office)
14:00	Opening Ceremony – Congress Hall in Municipality of Dobrich
	1-st Congress Session
19:00	Dinner
	Tuesday 21 st May
9:00 – 10:00	Morning Session
10:00 – 11:00	Break
11:00 – 12:00	Morning Session
	Lunch
14:00 – 20:00	Guided tour of Millstone Quarry & Aladzha Rock Cut Monastery
20:00 – 22:00	Welcome Party at place
	Wednesday 22 nd May
10:00 – 11:00	Morning Session
	Break
11:30 – 12:30	Morning Session
	Lunch
14:30- 15:30	Afternoon Session
	Break
16:00-17:00	Afternoon Session
	Dinner
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9:00 – 10:00	Morning Session
	Break
10:30-11:30	Morning Session – 3 x 20 min
13:30 – 20:00	Guided tour " Early byzantine cave monastery's colony
	Dinner
	Friday 24 th May
9:00- 10:00	Morning Session
	Break
11:00-12:00	Morning Session
	Lunch
14:00 – 15:00	Afternoon Session
	Break
16:00 – 17:00	Poster Session
19:00	Gala Dinner
	Saturday 25 th May
9:00- 19:00	Guided tour " Yailata cave city "
	Sunday 26 th May
9:00 – 18:00	Guided tour " Ivanovo & D.Besarbovski rock cut monasteries:"

PROGRAM OF PRESENTATIONS	
Time	Monday 20 th May
14:00	M.PARISE &ALL: The international congresses Hypogea/UIS 2015-2021
	SESSION : CADASTRE OF ARTIFICIAL CAVITIES / HYPOGEAN CIVILIAN DWELLINGS
	S.CALO &ALL: Cave settlements in southern Apulia. DDACO – the dynamic database of the artificial caves of Otranto
	C. CANAVAS: Tunnels of awe, justice and freedom: underground structures in modern literature
*	COFEE BREAK
17:10	T.BOBROVSKYY &ALL: Artificial cave shelters of the Phrygian highland (Turkey): defensive devices and principles of organisation
	Y.SHIVTIEL: Underground and Above-Ground Aqueducts from the Roman and Mamluk Periods in the Ancient City of Safad
Tuesday 21 st May	
9:00	T.BOBROVSKYY &ALL: The patterns of development of cave shelters in Cappadocia
	G.PASTURA &ALL : Orte (vt) – a complex hypogean heritage. New acquisition data
	S.MARGIOTTA &ALL: Inventory and analysis of underground oil mills in the territory of Lecce (Apulia, Southern Italy)
*	COFEE BREAK
12:00	F.DELL'AQUILA &ALL: Rock settlements on vertical cliffs in Matera
	A.SALKIN: Ancient man-made rock structures along the Black sea coast of Dobrudzha
	E.KLEIN&ALL: Excavations and surveys of underground cavities at Hurbat husham, Judean foothills
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	D.ALBOV Dmitry &ALL: Natural radioactivity in some caves of the Vayots Dzor province, Armenia
	M.PARISE &ALL: Knowing the underground, as the first step for hazard management: an experience in southern Italy, in the aftermath of a catastrophic collapse
	S.SHAHINYAN : The new policy of the government of the Armenia on protection of underground cultural and natural monuments
	COFEE BREAK
12.30	SESSION: RELIGIOUS STRUCTURES
	I.AGAPOV: Underground complex of Pskovo-pechersky dormition monastery (Pskov region, Russia)
	A.GUNKO&ALL : Central complex of Gochants cave monastery
	B.RIDUSH&ALL: Rock-cut caves of medieval Orhei (Republic of Moldova)
	LUNCH BREAK
14:30	L.CARNEVALI &ALL: Hypogea of San Pietro in Vincoli at Sant'Angelo in grotte
	G.FERRARI&ALL: Crypta Neapolitana (Naples, Italy) A multidisciplinary underground heritage site
	A.GUNKO&ALL: Cave complex in Valuiki
*	COFEE BREAK
17.30	K.STOICHKOV : Creation of new map documentation of the rock cloisters on the periphery of Shumen's plateau 2012 - 2019
	V.STEPKIN : Via Crucis in the caves of Divnogorsky monastery in Voronezh region, Russia
	E.IANOVSKAIA: Architectural peculiarities of religious cavities complex in the Ihlara valley (Cappadocia)
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	B.ZISSU &ET ALL : Underground explorations at Horvat Qasra, southern Judean foothills, Israel
	N.BAKHTADZE: New considerations on the architectural structure of the Vardzia rock-cut ensemble and peculiarities of the ongoing monastic life
	COFEE BREAK

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	V.CALOI&ALL: The artificial drainage system of Gabii (or Castiglione) lake in Latium, Italy. A comparison among the investigations of the '90s and a recent study aiming at a possible restoration of the Old lake basin
	A.ZHALOV&ET ALL: Water intakes and sewage facilities of Bulgarian St.George the Zograf monastery in Mount Athos, Greece
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SESSION: MINING WORKS	
9:00	G.BELVEDERI &ALL: Iron hearth: the re-exploration of the old mine “Manina” (Italy)
	G.FERRARI &ALL: Sasso rancio: an iron mine on Lake Como (Italy)
	D.GARSHIN &ALL: Underground limestone quarries in Tula region, Venyov district (Russia)
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11.30	M.LEONTEV : Limestone mines nearby village Maleevo Ryazan region
	R.RUGGIERI&ALL: The geosite of Tabuna and Streppenosa asphalt mines (Ragusa, South-east Sicily)
LUNCH BREAK	
14:00	K.SCHUCHOVÁ &ALL: The problem of abandoned mines – only hazards? A case study from the Nížký jeseník upland (Czech)
*	SESSION: MILITARY AND WAR WORKS (DEFENSIVE)
15.30	R.BIXIO &ALL: Second world war air-raid shelters in genoa (Italy): knowledge, protection and use of an underground historical and cultural heritage in urban environment
	POSTER SESSION

THE ROCK MONASTERIES AND CHURCHES IN BULGARIA





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