

VOLUME 82
ISSUE 12

DECEMBER
2024

NSS NEWS

AMERICA'S CAVING MAGAZINE

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THIS
MONTH



THIS MONTH'S COVER

Grey and yellow stalactites in the Flat Chamber.
From the article on page 4.

Photo by Philippe Crochet

CALENDAR OF EVENTS

December 14, 2024

Annual Cumberland Caverns Caver's Christmas Party, McMinnville, TN. For reservations and info, email Nicole@cumberlandcaverns.com.

January 21 to 25, 2025

85th Anniversary of the Speleological Society of Cuba, International Congress. At Playa Los Bajos Gibara, Holguín, Cuba. See more details at: <https://www.fealc.org/index.html>

January 25th, 2025

Invitation to attend the Arizona Regional Association of the National Speleological Society's 2025 Winter Technical Session. at the Prescott Public Library, 125 E. Gurley St. from 9:00 am to 5:pm. A free annual series of presentations on a wide variety of cave-related topics. Persons wishing to make a presentation should submit a Title and brief Abstract at least two weeks in advance to: Mike Van Note micvannote@gmail.com 928 631 9149 or Ray Keeler rckeeler@cox.net 623 523 1760

Jan 27 to Feb 2, 2025

Hawaii Cave Week, organized by the Hawaii Grotto and the Cave Conservancy of Hawaii. Beat the winter blues in Hawaii! Email to reserve a spot, hawaiigrotto808@gmail.com. Web page at hawaiigrotto.com.

May 2 to 4, 2025

SERA Cave Carnival, to be held at East Fork Stables Campground near Jamestown, Tennessee in prime cave country. Hosted by East Tennessee Grotto. Information posted <http://sera2025.subworks.com>.

May 23 to 26, 2025

40 th Annual Ennis Cave blowout near Mt View, Arkansas. Caving, campfire socializing, and great food and people. Contact Randy Rose at 714-697-0037 or randalrose@sbcglobal.net

June 21 to 28, 2025

NSS Convention, Cobleskill New York. Celebrating a "Lifetime of Caving." Registration is open at <https://caves.org/convention/2025-nss-convention/>



October 6 to 10, 2025

National Cave and Karst Management Symposium in Ely, Nevada, and hosted by the Western Cave Conservancy. See: <https://ely2025.nckms.org/>

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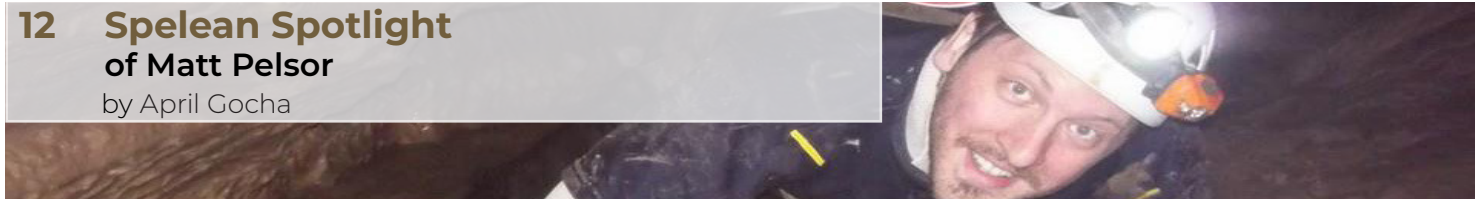
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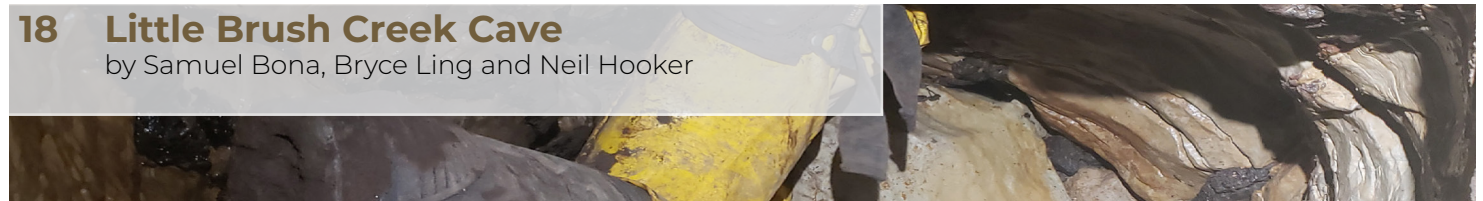
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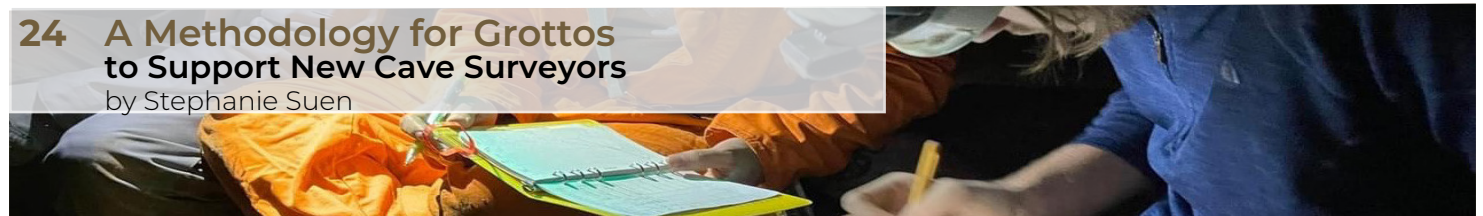
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Photo by Philippe Crochet



The Köýtendag 2024 French Expedition to Turkmenistan

by Philippe Crochet and Annie Guiraud

This Article is by Philippe Crochet and Annie Guiraud with assistance from Philippe Audra, Lionel Barriquand, Jean-Marie Briffon, Gaël Cazes, Jean-Philippe Grandcolas, Josef Grego, Jean-Pierre Gruat, Jean-Paul Hérel, Bernard Lips, Josiane Lips, Frédo Poggia, Alexandre Pont, Xavier Robert and Jo De Waele

How it all started

The story begins in 2019, during preparations for a reconnaissance expedition to the karst massifs of southern Uzbekistan. Jean-Marie Briffon, Claire Falgayrac, Noël Crosetti and Jean-Pierre Gruat decide to take a close look at the base of the great cliffs of the Köýtendag massif (formerly Kugitang or Kugitangtau), which they have spotted on a map. Little is known about this massif, which is the final link in the Gissar Mountains. These begin in Tajikistan, north of Dushanbe, and extend into the Baisun Tau massif, which includes the Chul Bair range (home to the Boy-Bulok and Vishnechsky caves) and the Hodja-Gur-Gur-Ata range (home to Dark Star Cave) in Uzbekistan.

The group heads for the highest Uzbek village (Vandob, 1,800 m), closest to the foot of the immense limestone walls of the Köýtendag (600 to 1,200 m altitude), which stretch over 60 km in length. The aim of exploring the bottom of the cliff for a few days and looking for cave entrances proves impossible, as they can't

get permission from the Uzbek military to go any further than Vandob. However, they are enthusiastic about what is visible in the cliff: Steep gradient, good quality limestone and numerous cave entrances. After searching for documentation on the massif, mainly from Russian sites, it turns out that various articles were written by a Russian geologist (Vladimir Maltsev, 1957 to 2014) and deal with the Gap-Gotan cave system (Cupp-Coutun), which he studied in the 1980s and 1990s. The rest has been little explored since the fall of the USSR, as it lies on the border between Uzbekistan and Turkmenistan, and the massif is classified as a national reserve on the Turkmen side, but everything confirms the geographical, geological and karstological interest of the Köýtendag massif, which has been left untouched by cavers for about 30 years.

Jean-Pierre therefore plans a caving expedition to Köýtendag in 2020. However, this can only be achieved in 2023, due to the Covid 19 pandemic and the long administrative procedures required to get the necessary permits.

Prior administrative procedures

To get a visa for Turkmenistan, you need a letter of invitation from a government-accredited tourist agency. This invitation is issued by the State Migration Service. After some consultation, we select Owadan Tourism agency. Many e-mails are necessary to

explain that we have specific needs and objectives, quite different from those of the few tourists who visit this country. The agency quickly appoints Mrs Dilora Geldiyeva, the agency's Business Development Manager, as our contact person, as she speaks very good French.

Starting in 2021, several letters are sent to the Minister of Agriculture and Environmental Protection of Turkmenistan to present our project and request the necessary authorizations for 2022. Because of its border location and its status as a national reserve, access to Köýtendag requires a great deal of planning and authorization and even more so to explore its caves. Fortunately, the Turkmen ambassador to France, Mr. Chariev, actively supports our project. Thanks to him, in 2023 and 2024, we get the invitation letter from the Turkmen Ministry of Foreign Affairs. Similarly, the French ambassador to Turkmenistan, Mr. Merlin, supports our expeditions.

But when we arrive in 2023, we discover that the main caves are located in a military zone. Thus, access in 2023, and then again in 2024, was only obtained with the help of the Turkmen ambassador. Only access to the ridges and high plateaus of Mount Aýrybaba is denied, as they are too close to the Uzbek border.

Geographical features of the Köýtendag region

Köýtendag means “impassable mountain” in Tajik. The Köýtendag massif is the last western part of the Pamir-Alai mountain chain, which extends further east towards Tajikistan, Kyrgyzstan and Uzbekistan. The Köýtendag forms Turkmenistan’s eastern border with Uzbekistan, and its southern tip ends on the right bank of the Amou Daria, the border river with Afghanistan. The massif culminates at Ayrybaba (3,139 m), the highest point in Turkmenistan. The massif is elongated in a north-south direction for around 60 km, with a width of 12 to 20 km. Its profile is asymmetrical, with a slope on the Turkmen side rising steadily eastwards at a gradient of 20° to the summit ridges, ending abruptly on the eastern side in Uzbekistan at a continuous wall, a 1,000 m high. The slope of the Turkmen side is mainly structural. It is cut by a multitude of canyons, more than 300 m deep and up to 700 m, making travel on

the contour virtually impossible.

At higher altitudes, the vegetation changes from grassland to open juniper and tamarisk forest, then to rocky areas. Further west, steppes stretch out, followed by the Karakum desert, which occupies most of Turkmenistan’s territory. While rainfall is limited to 120 mm a year in Köýtendag, at the gateway to the desert, it is more abundant at the foot of the massif (150 mm a year) and probably twice as much at higher altitudes. Being a continental climate, summers are scorching, but winters can be freezing, with temperatures dropping to -15° C in the valleys, despite being at the same latitude as Sicily. Winter 2024 was particularly harsh, with snow on the plains and temperatures down to -25° C. As a result, snow continues to fall on the ridges in spring, feeding small springs at the mouths of some canyons. The largest of these, Gaynar Baba, gushes out at the southern end of the massif at an altitude of 330 m, with an estimated flow rate of 1.5 m³/s. All

these flows are lost on the plain where the Amou Daria flows, at around 265 m altitude.

Geology of the massif

The karstified strata is made up of Upper Jurassic limestones, 400 m thick, with a massive reef facies and large corals, changing to a more marly and dolomitic facies at the top. In places, these limestones are slightly metamorphosed and silicified, and trap bituminous material that is probably partly responsible for the karstification [Maltsev, 1997]. Indeed, further east, these limestones are the main Turkmen reservoir trapping gases from the underlying black marls. These marls/flysch (Bathonian-Bajocian) are 300 m thick, with some volcanic layers. This sedimentary series rests unconformably on the Precambrian metamorphic basement, which is composed of gneiss and pierced by the intrusion of a Hercynian granitic batholith [Maltsev & Self, 1992]. The Köýtendag limestones are

Photo Page 4: Geophysicheskaya Cave, with chandeliers on the ceiling of the Pink Chamber. This Page: A wall covered with multi-colored curtains in the “Red Passage” of the same cave. Photos by Philippe Crochet



concordantly overlain by the 200 m-thick Gowurdak (or Gaurduck) evaporites, mainly composed of gypsum (Kimmeridgian-Tithonian). These evaporites are overlain by green marls and red sandstones of Cretaceous age, forming superb, gullied landscapes on the western slope (right bank) of the Köýtén valley. Finally, Neogene deposits fill in the surrounding basins.

The Köýtendag is an asymmetrical anticlinal dome, with gentle dips (approx. 7-20°) on the western side. It is broken by major north-south faults, including the Chilghaz fault, which cuts the plateau into two "steps." To the north, mines have exploited lead-zinc deposits in veins along one of these faults. Other secondary E to W and NW to SE faults play a role in controlling the pattern of caves located to the south. The Amou Daria corridor is formed by the large regional E to W Repetek fault, which runs along the southern edge of the massif. The massif was uplifted in several phases, from the early Tertiary (Paleocene) to the middle Quaternary [Maltsev & Korshunov, 1998]. On the limestone plateau, karstic features are non-existent: There is no karren, no dolines and even fewer sinkhole entrances. The large cave systems such as Cup-Coutunn are former deep systems that have been fortuitously intersected by canyons creating entrances.

Exploration History

The Gap-Gotan cave system in Turkmenistan was already well known two thousand years ago ("Bibliotheca Historica" by Diodorus Siculus, 49 BC). Knowledge of these caves was lost until the early 1950s. As in the other former republics of the Soviet Union in Central Asia (Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan), caving expeditions were mainly carried out by Russian teams until the 1990s.

The first speleological explorations took place between 1956 and 1964, by Russian geologist Sultan Yalkapov, who drew up the first plans for Hashimoyuk (3 km) and Gap-Gotan (5 km), and also discovered new caves. Unfortunately, Yalkapov published an article suggesting the possibility of extracting its onyx for ornamental purposes. Mining began in the late 1950s and continued for 20 years, resulting in significant damage to these caves.

Little is written about the first visits prior to the 1980s. One of the first explorers in 1981 at Promezhutochnaya was Soviet mineralogist Victor Stepanov. Vladimir Arkadievich Maltsev of Moscow's VNIIGEOSYSTEM Institute, (1957-2014) arrived in the region in the 1980s. As a geologist, speleologist and photographer, he was one of the pillars of the exploration of the Köýtendag massif. Samarkand cavers also

discovered new caves and extended Gap-Gotan. A very big extension was also found during mining work in the small Promezhutochnaya cave.

Between 1970 and 1982, the mining industry destroyed so many caves that Maltsev launched a campaign in 1980 to put an end to it and promote their protection. This year-long campaign was widely supported, in particular by speleologists, scientific institutes and the media. Much to Maltsev's surprise, the campaign bore fruit, despite a few attempts at re-exploitation.

Study of the caves began when mining ceased. The Gap-Gotan cave was connected to the Promezhutochnaya cave, bringing the system to a length of 56 km. New caves were discovered, including the Gulschirin Cave (Geophysicheskaya) in 1985, one of the most beautiful caves since it escaped destruction.

After the fall of the USSR, there were a few small-scale expeditions by European teams: A British expedition in 1991 and a Russian-Swiss expedition to Köýtendag in 1994 (see *Cavernes* magazine, n. 1/2, 1995). Giovanni Badino, José Maria Calaforra and Paolo Forti from the Italian association La Venta made a visit to Gap-Gotan and the Köýtendag region during a congress held in Ashgabat in 2012.



THE ENTRANCE OF THE WHITE PASSAGE IN GEOPHYSICHESKAYA CAVE, TURKMENISTAN. PHOTO BY PHILIPPE CROCHET



RED PASSAGE WITH GYPSUM ON THE WALLS OF GEOPHYSICHESKAYA CAVE IN TURKMENISTAN. THE RED COLOR IS DUE TO PYRITE.
PHOTO BY PHILIPPE CROCHET

Expedition Organization

The second expedition to Köýtendag in April 2024 involved a 17-person multidisciplinary team, with specialists in topography, photogrammetry, biospeleology, geology, karstology, photography and exploration. After the 2023 reconnaissance, we have defined two main objectives: to document the known caves and to search for new ones. Our base camp is the so-called “vacation village,” the valley’s main tourist accommodation. Conditions are very comfortable. The Owadan agency, in charge of the logistics for our expedition, has done a very good job. And last but not least, we have the invitation letter from the Turkmen Ministry of the Environment giving access to the border zone with Uzbekistan where the caves are located.

To organize our activities in the field,

we have to deal with various constraints and obligations. First of all, teams have to be formed each day so that they can be distributed among the four 4x4 vehicles at our disposal. While some people are dedicated to a single activity, others join different groups as required. Trips to look for new caves on the massif require several vehicles, as it is better not to venture out on mountain roads in a single vehicle. We need to organize the teams the day before so that the authorities can be informed.

And then there’s the time and schedule management. Köyten is a 40-minute drive from the checkpoint at the entrance to the military zone where the main caves are located. The checkpoint opens at 9 am. After our permits have been checked, we have a 30 to 45 min drive on a dirt road to reach the caves. As the checkpoint must be passed on

the way back by 5 pm at the latest, we have only a few hours left to explore the caves. Each day, we are accompanied by the scientific director of the Köýtendag nature reserve, Shaniyaz Menliev.

In 21 days, a great deal of documentation has been completed: the Gulschirin (Geophysicheskaya) cave has been photographed and rendered in 3D, a total of 19 km of caves have been surveyed, several openings in the canyon walls have been found and explored, and the work of the biologists has led to the discovery of species new to Turkmenistan and to science. These initial results were presented at a conference held on May 1, 2024, at the French Institute in Ashgabat, in the presence of Mr. Merlin, French Ambassador to Turkmenistan.

Gypsum Crystals

The underground cave systems of the Köýtendag contain amazing gypsum crystallizations (chandeliers, hollow stalagmites, etc.) of a scale and beauty comparable to those of Lechuguilla Cave in the US. Here, the gypsum comes partly from the overlying soils: Tiny seepage with dissolved sulfates precipitates as it enters the galleries. The other part comes from the oxidation of pyrites contained in the rock (wall crusts, flowers and crosses). All these gypsum decorations can crystallize thanks to the very dry atmosphere of the caves. In more humid climates such as Europe and the eastern US, the highly soluble gypsum mostly disappears. Chandeliers are formed of large, transparent gypsum crystals, by slow growth at the tip. Other crystallizations are formed by fibers that grow from the base, like blades of grass. Crosses are made up of several fibers that bend or even curl as they develop, often from oxidizing pyrite. Needles grow from the evaporation and crystallization of sulfates dissolved in loose sediments.

The countless hollow stalagmites in the Köýtendag caves, reaching several meters in height, are the result of condensation and evaporation. Condensation occurs in the higher, cooler domes. Condensation dripping falls to the ground and dissolves the thick gypsum dust mat, creating a fluted shaft. As the cave atmosphere is very dry, moisture from the bottom of the shaft rises by capillary action, dissolving the gypsum and loading itself with sulfates in solution. Once it reaches ground level, this moisture evaporates and re-precipitates the gypsum in the form of a rim around the shaft. Over time, this rim expands upwards and in thickness, gradually forming a stalagmite whose hollow is maintained by the falling drops of condensation.

Looking for new caves

The search for new caves is a major objective of our expedition. In 2023, access to the mountain section was not possible, but this year we are allowed to cover the whole massif, so we focused our search on four main areas. On the plain at the north-western foot of the massif, the limestone disappears beneath a cover of gypsum. Philippe A. and Xavier have spotted dark spots on Google Earth that look like resurgences. In fact, these are real cenotes, and we made an inventory of them. These vegetation-free gypsum zones are home to classic karst features: Alignments of huge sinkholes, shafts, cracks, as well as depressions up to 70 m in diameter resulting from the collapse of vast

chambers. We found caves known to the Russian teams, which we mapped, but we also made few discoveries. At the north-western end, exploration of a small gypsum massif also leads to the discovery of small cave systems. But the breakdown rocks make it difficult to push forward. The potential is also limited by the small size of that area.

A second focus of research is the exploration of the many canyons, some of which are dozens of kms long, that descend from the summit ridge. In places, the walls feature dark spots that look like cave entrances. Most of the time, however, these are simply pockets with no leads. After a tricky climb, Xavier and Gaël find a passage a few dozen meters long. In another canyon, two openings, appear in the middle of a 300 m vertical cliff, but lead to nothing! Apparently, the canyons in this sector don't intersect with former systems.

Another search area is at the south-western end of the massif, in the military camp in the canyons around the known caves. The team encounters the same difficulties as on the rest of the massif. But here, the caves exist. In addition to the major known caves that we have documented, Russian teams have listed some twenty caves less than 500 m long. They remain untraceable and the camp guards don't seem to know about them. How can we find these entrances without the help of the locals who discovered them in the first place?

Finally, the last objective is to find high altitude entrances. However, we can't venture very high by car on mountain tracks. At around 1,100 m, the team crosses an immense sloping plateau covered in grass, with no karstic features. At around 2,400 m, they reach an antecedent hill that gives them a glimpse of the summit zone. The landscape there is purely mineral. To the east, the snowy summit of Aýrybaba dominates, 700 m higher up. On the Russian map, a cave is marked: It is 700 m away and 150 m higher. The team tries to reach it, but alas, a canyon with vertical walls a hundred meters deep quickly cuts off their progress. Getting around it would take several hours and their time is limited. They have to give up! Using binoculars, however, Gaël spots entrances further up the opposite wall. What a frustration not to be able to go there!

Survey

Surveying was one of the main aspects of the expedition, with a large team made up of Jean Paul, Alexandre,

Jean-Pierre, Bernard, Jean-Philippe, Jean-Marie, Xavier, Jo and Philippe A. Although maps of the main systems had already been made by Russian cavers in the 1980s, they were not available in detailed format with only paper versions. In addition, techniques have considerably evolved: a laser-aimed Disto X is now used for measuring and the data are collected by mobile phone using Topodroid. Calculations and drawings are then made on computer using Therion or Topo Calc'R software. A surveying team was generally made up of three people: One in charge of notes, one measuring with the Disto X, and the last one in the role of scout, called "rabbit," who ran ahead to spot passages, crossroads and stations.

In the end, a great deal of work was carried out: Up to five teams a day were dedicated to surveying. They visited 15 caves and surveyed some 19 km of passages, representing 8,571 topographic stations. Although the possibility of new discoveries was limited, and considering that the calcite collectors and Russian expeditions in the 1990s were effective explorers, all these maps provide a global view of the systems known to date and of the potential for future exploration.

Photogrammetry of Geophysicheskaya Cave

In addition to the mapping work, Geophysicheskaya Cave (the most well-preserved and beautiful of the caves in the area) was the subject of a 3D photogrammetric modeling operation. The aim was to digitize all or part of the cave in order to accurately record its geometry, thus serving as a working basis for karstologists (study of passages structures, clues to speleogenesis, zonation of wall morphologies and gypsum formations, etc.) but also later to offer an immersive vision of this exceptional cave to complement the photographs.

For this project, Gaël (a PhD student at Géosciences Montpellier and Cenote), equipped with a powerful LED projector and a pair of GoPro-type cameras, traveled the length and breadth of the Geophysicheskaya passages over four days. The acquisition and positioning of the photographs thus depended on the route taken through the passages, planned to avoid shadow zones and maximize image overlap, essential to the accuracy of the final model. Photogrammetric photography aims to generate a maximum number of flat, unattractive images in a minimum amount of time. Over 50,000 shots covering more than 1.3 km of passages from a variety of angles (floors, ceilings, boul-



CAVER INSIDE A GIANT HOLLOW GYPSUM FORMATION CALLED, THE PRISON IN HASHIM-OYUK CAVE IN TURKMENISTAN.
PHOTO BY PHILIPPE CROCHET

ders, walls, formations, etc.) were taken to form the basis of the subsequent photogrammetric calculation.

These images were then processed to generate a final 3D envelope, which could be geo-referenced using the pre-existing topographical markers left by the survey team, thus ensuring correct spatial positioning and accuracy. The results obtained have confirmed the feasibility of photogrammetry for large-scale digitization projects, offering a good alternative to LIDAR when the time available underground is a limiting factor.

Underground biology of the Köýtendag

Studying the biodiversity of the subter-

anean world is extremely important, as it is inhabited by animal species often classified as climatic relics, capable of surviving millions of years of global climate change.

The study of the underground fauna of the Köýtendag was started in 1963 by Russian teams [Birstein & Ljovushkin, 1967]. From 2013 to 2015, an extensive research program on the fauna of Turkmenistan was carried out. The fauna determined came from six caves and four former mines as well as from various springs. Two new species of *Gammarus* were collected (one of which is an evolved troglobite), as well as Turkmenistan's first terrestrial troglobite: a diplura *Turkmenocampa mirabilis*, new to science and Central Asia's first diplura.

In 2023, Josiane Lips was the only biologist on the expedition, and in 2024 she worked together with Josef Grego, a Slovakian mollusc specialist. On both expeditions, terrestrial and aquatic fauna from eight caves, four former mines and a dozen springs were sampled. The fauna varied greatly from one cave to the next, both in terms of quantity (of specimens and species) and composition. Overall, however, the underground fauna was relatively poor, due to the fact that most of the caves are very dry. However, around 150 species of terrestrial invertebrates were recorded underground. It is already possible to say that many of the species collected are new to Turkmenistan, and several would be new to science.

In addition, the study of the spring fauna has led to the identification of most of the species mentioned in the literature, but also to the collection of many new species. The subterranean freshwater fauna contains several relics of gastropod and crustacean species from the ancient briny lake Paratethys, and their ongoing molecular study could provide very important information on the formation of the Tajik Basin and the Caspian Sea.

The 2023 expedition took place in May, while the 2024 expedition took place in April. Climatic conditions were different, with cooler, wetter conditions in 2024. As a result, the cave fauna was very different: some species that were very common in 2023 were absent in 2024, and conversely, groups that were absent in 2023 were represented in many caves and by various species in 2024. This may reveal a seasonal variation in the cave fauna.

Photographic documentation of caves
Photographic documentation is an essential part of an expedition, unfortunately all too often neglected, as it enables the expedition to be promoted, particularly for communication purposes (reports, articles, sponsorship requests). Moreover, in the case of this expedition, this aspect was put forward to get permits from the local authorities, who were very receptive to the idea, seeing it as a way of highlighting the richness of their heritage. Bibliographic research had revealed only a few black-and-white photos dating back to Russian explorations over 40 years ago, and some more recent ones taken by Rémy Wenger during a short expedition in the 1990s and by Maltsev. The Gulschirin cave (Geophysicheskaya) had hardly been documented at all (except by Maltsev). Philippe C. and Annie therefore faced a major challenge, and devoted themselves entirely to this part of the expedition. They were assisted by members of other teams, so that they were able to work in teams of three or four, which is an optimal configuration.

The main focus was on documenting Gulschirin (Geophysicheskaya), an exceptional cave. Knowing that time in the country and the daily hours were limited, it was necessary to produce images that would reveal its beauty, and reveal the entire cave. The main objective was of course to illustrate with lighting that emphasized the subjects. In this context, there was no room for artistic research, which would have been unnecessary given the natural beauty. Photographs were taken only with electronic flash units of varying power (Yongnuo 560III, Godox AD300

and Godox AD600). A total of thirteen days were devoted to photography, with eight trips to Gulschirin (Geophysicheskaya) (even if the possibilities for beautiful images are endless), three to Hashim-Oyuk, one to Promezhutochnaya and one to Kaptarhana, with an average of around ten shots per trip.

At the end of the expedition, the pho-

tographs were donated to the Turkmen authorities, who will be able to use them to support an application for UNESCO classification, a long-standing project that has not yet been completed. We hope they will also be able to motivate them to provide future expeditions with the necessary authorizations to search for caves on the plateau, and to encourage them to protect the caves.



BACKLIT FORMATION PHOTO BY PHILIPPE CROCHET

December 2024

