

Ice Cave Map Pioneering: Russian Experience

Introduction

Geologically more than 60% of the territory of Russia consists of karst rocks, and approximately seven thousand caves have been discovered and explored. Bearing in mind the Russian cold climate conditions, a large number of ice caves were found. The exploration of Russia's underground regions began in the early eighteenth century, mostly in connection with academic expeditions; the geographers not only described the caves, but created cartographic charts as well.

Materials and Methods of Exploration

The first map of Kungur Ice Cave, situated in the Central Urals (Fig. 1), was published in 1730 in Stockholm by a captain in the Swedish army, F. I. Tabbert von Strahlenberg (Strahlenberg 1730) (Fig. 2). During 1721 and 1722, Captain Tabbert worked in the Daniel Gottlieb Messerschmidt Siberian expedition where, supposedly, he copied the plan of Kugnur Ice Cave drawn by the Russian cartographer S. U. Remezov in 1703.

But a more comprehensive map of Kungur Ice Cave was plotted by Professor Johann Georg Gmelin (Fig. 3). He took part in the Siberian group of the Great Northern expedition and visited the cave on 23 December 1733, accompanied by the painter Johann Christian Berckhan and Professor Gerhardt Friedrich Müller. According to Gmelin (1751), Berckhan endeavoured to make the best possible plan of the cave, though lacking a knowledge of underground geometry; the directions of passages were determined by a magnetic compass, and the distances were measured in paces.

The paces were transformed subsequently to sazhen (1 sazhen is

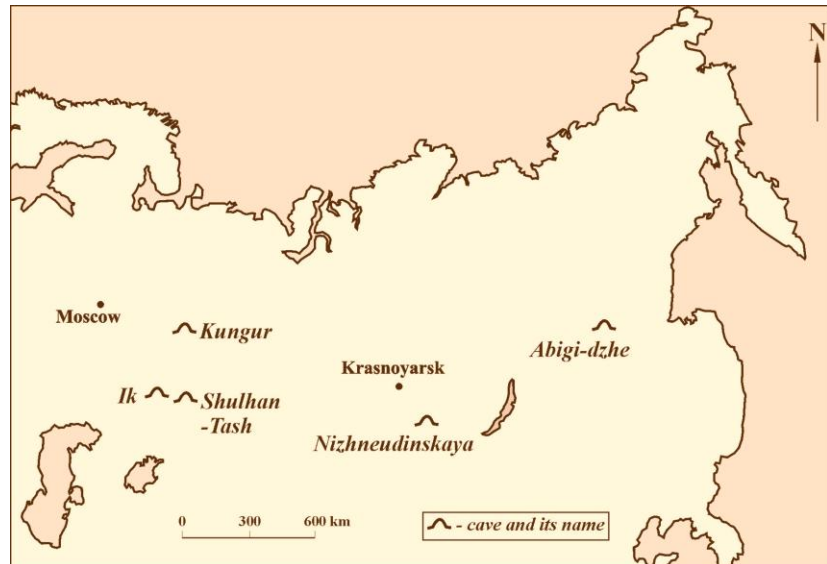


Fig. 1 Area studied

Slika 1. Područje istraživanja



Fig. 2 Plan of Kungur Ice Cave (after Strahlenberg, 1730)

Slika 2. Karta ledene špilje Kungur (prema Strahlenbergu, 1730)

Karte ledenih špilja: iskustva iz Rusije

Uvod

U geološkom smislu, više od 60% teritorija Rusije pokrivaju krška područja, u kojima je pronađeno i istraženo približno sedam tisuća špilja. Shodno tome, s obzirom da se Rusija nalazi u području hladne klime, pronađen je velik broj ledenih špilja. Istraživanje podzemnog prostora u Rusiji započeto je početkom 18. stoljeća tijekom akademskih ekspedicija: geografi nisu samo opisivali špilje, već su ih i prikazivali kartama.

Materijali i metode istraživanja

U središnjem dijelu Urala (sl. 1) nalazi se ledena špilja Kungur, čiju je prvu kartu (sl. 2) objavio 1730. u Stockholmu zapovjednik švedske vojske F. I. Tabbert von Strahlenberg (Strahlenberg 1730). Godine 1721. i 1722. Tabbert je sudjelovao u sibirskoj ekspediciji Daniela Gottlieba Messerschmidta kada je, navodno, prekopirao kartu ledene špilje Kungur koju je 1703. izradio ruski kartograf S. U. Remezov.

Sveobuhvatniju kartu te špilje izradio je profesor Johann Georg Gmelin (sl. 3). On je bio član sibirske skupine u Velikoj sjevernoj ekspediciji i posjetio je tu pećinu 23. prosinca 1733. zajedno sa slikarom Johannom Christianom Berckhanom i profesorom Gerhardtom Friedrichom Müllerom. Prema Gmelinu (1751), Berckhan je nastojao izraditi kartu špilje što je bolje moguće za osobu koja ne poznaje podzemnu geometriju: smjerove prolaza utvrđivao je uz pomoć magnetske igle, a udaljenosti je mjerio koracima.

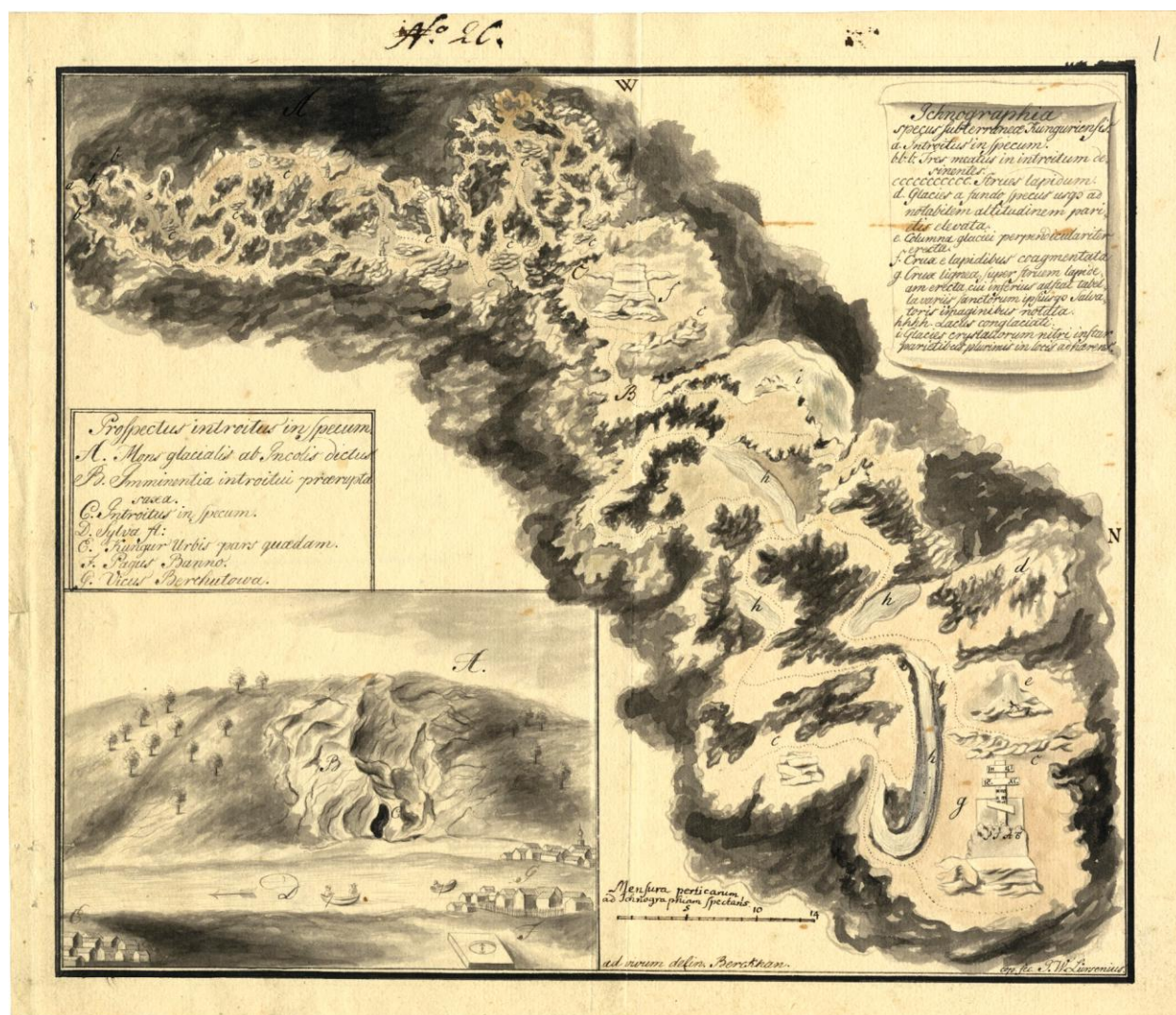


Fig. 3 Plan of Kungur Ice Cave (after Gmelin, 1751)

Slika 3. Karta ledene špilje Kungur (prema Gmelinu, 1751–52)

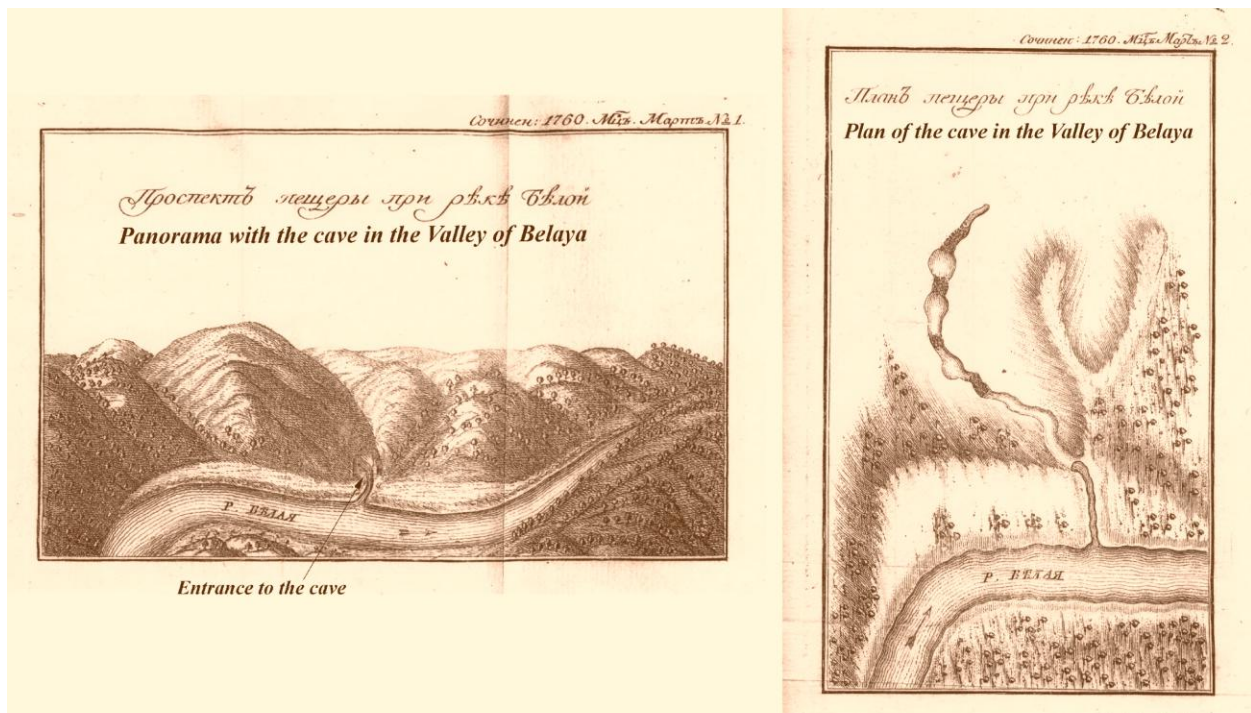


Fig. 4 Shulgan Tash Cave: left – panorama of karst massif with cave entrance, right – plan of underground cavity (after Rychkov, 1760)

Slika 4. Špilja Šul'gan-Taš: lijevo – panorama krškog masiva s ulazom u špilju, desno – karta podzemne šupljine (prema Ryčkovu, 1760)

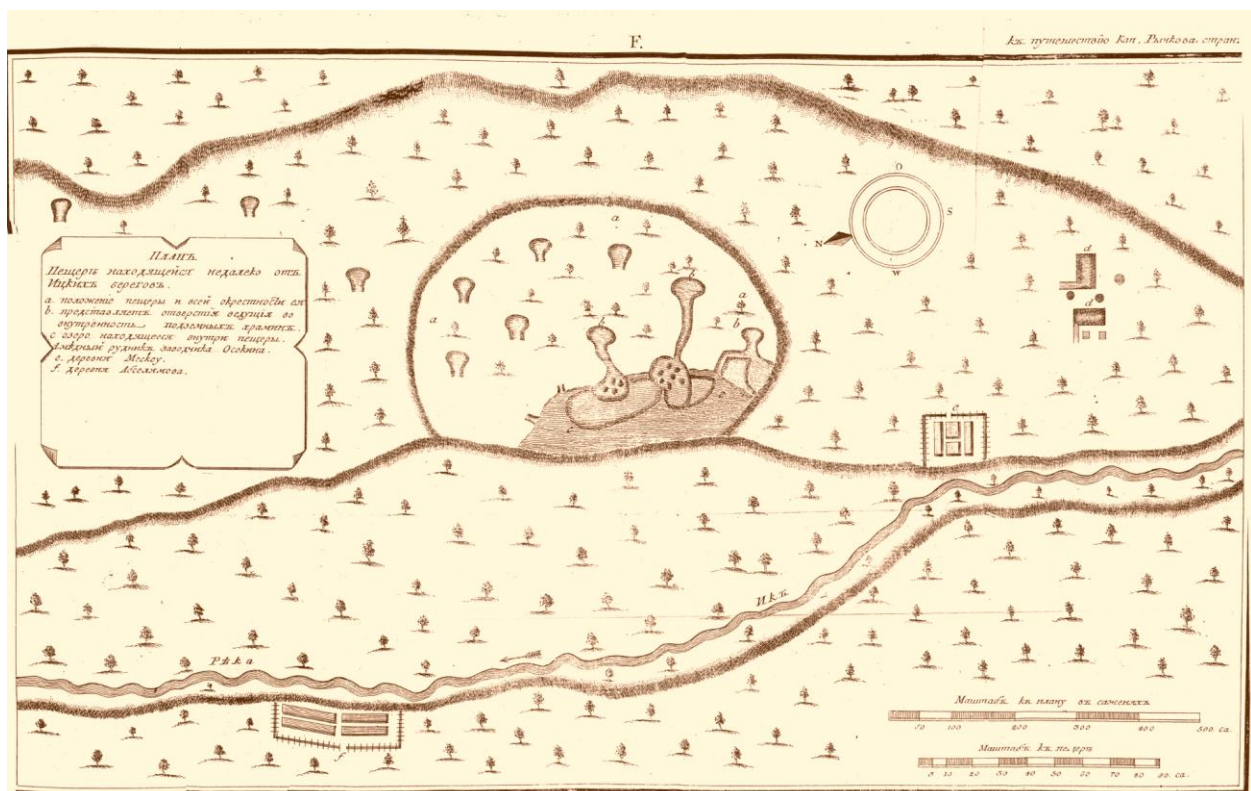


Fig. 5 Plan of Ik Ice Cave (after Rychkov, 1770): a – cave location and surroundings, b – cave entrances, c – lake situated inside the underground cavity, d – copper mine, e – village of Mekey, f – village of Abselyamovo)

Slika 5. Karta ledene špilje Ik (prema Ryčkovu, 1770): a – položaj špilje i okolina, b – ulazi u špilju, c – jezero unutar podzemne šupljine, d – rudnik bakra, e – selo Mekej, f – selo Abseljamovo)

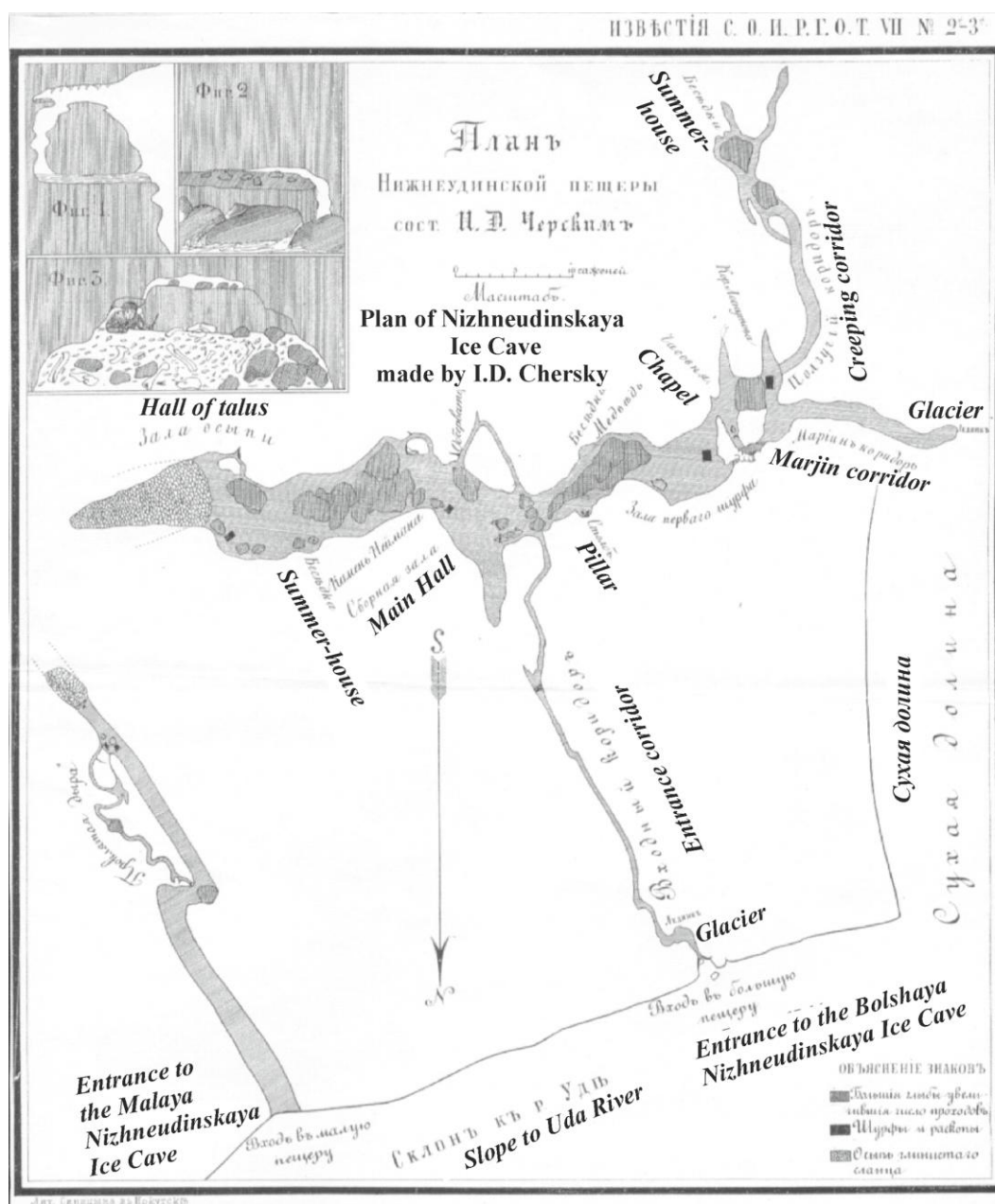


Fig. 6 Plan of Nizhneudinskaya Ice Cave (after Chersky, 1876)

Slika 6. Karta ledene špilje neudinskaja (prema Čerskome 1876)

Korake je kasnije pretvorio u sažen' (1 sažen' iznosi 2,1336 m). Gmelin je primijetio mnogo ledenih formacija u podzemnim šupljinama, koje lokalno stanovništvo naziva ledjanaja – (ledena) špilja, zato što je temperatura zraka u njima mnogo niža od one na površini.

Dana 7. siječnja 1760 Petr Ivanovič Ryčkov zajedno s vojnicima i Baškiri-ma istražio je i pripremio vanjsku panoramu i kartu špilje Šul'gan-Taš (sl. 4), koja se nalazi na južnom dijelu Urala. U tri je sata izmjerio 160 sažen'a

špilje i uočio ogromne šupljine: “Potrebno je provesti ovdje nekoliko dana kako bi se sve razgledalo” (Ryčkov 1760, str. 210). Opisao je ledene ukrase koji se nalaze blizu ulaza, a od kojih su neki široki kao čovjek, a dugački jedan i pol sažen'. Također je zabilježio iznimnu toplinu unutar šupljine, premda je na površini bila velika hladnoća.

Ledenu špilju Ik koja se nalazi na desnoj obali rijeke Ik (dolina Belaja) opažao je i kartirao N. I. Ryčkov 25. lipnja 1770. (sl. 5). Sljedećim je riječima opi-

sao veliku hladnoću unutar špilje, koja se povećava od ulaza u dubinu špilje, gdje se nalazi čvrsti led: “Moguće je stajati na površini tog leda” (Ryčkov 1770, str. 95).

Godine 1876. I. D. Čerski objavio je rezultate istraživanja i kartiranja ledene špilje Nižneudinskaja (sl. 1), koja se nalazi u istočnom dijelu Sajana, a uključuju dvije šupljine koje dijeli talus: Bol'shaja i Malaja (sl. 6). To je prvi puta da su kartografski prikazani položaji dvaju glečera i prvi put da je neki istraživač predložio kondenzacijsku

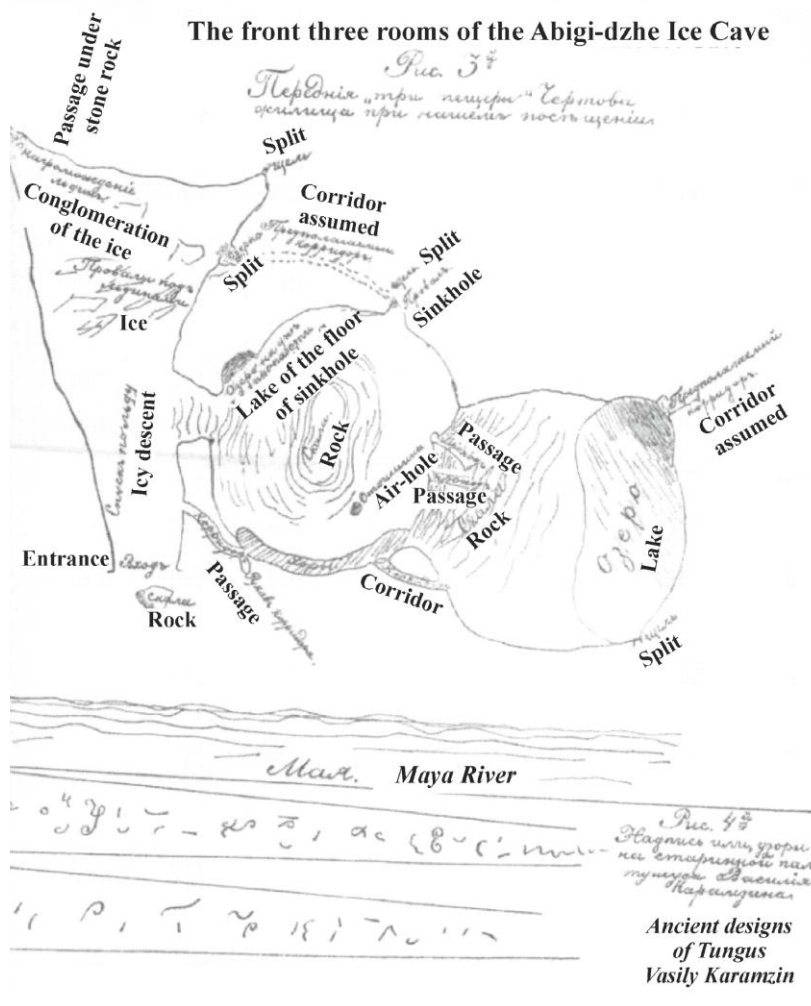


Fig. 7 Plan of Abigi-dzhe Ice Cave (after Stephanovich, 1896)
Slika 7. Karta ledene špilje Abigi-dzhe (prema Stefanoviču 1896)

equal to 2.1336 m). Gmelin noted a great deal of ice formations in the underground cavity, which was called ledyanaya (Icy) cave by the local people, because the air temperature inside was considerably lower than at the surface.

On 7 January 1760, P. I. Rychkov, with some soldiers and Bashkirs, explored and prepared the external panorama and plan of Shulgan-Tash Cave (Fig. 4), located in the Southern Urals. In the course of three hours, he surveyed 160 sazhen of cavern and pointed out the enormous cavity sizes. "It is necessary to spend several days for a full investigation" (Rychkov, 1760, p. 210). The ice formations near the entrance, some of which

were the thickness of a man and one and a half sazhen in length, were described by him in the cave, and the unusual heat inside the cavity, even though there was severe cold at the surface, was marked.

Ik Ice Cave, discovered on the right bank of the River Ik (Valley of Belaya), was observed and mapped by N. I. Rychkov on 25 June 1770 (Fig. 5). The investigator described the severe cold inside the cavity, which increased from the entrance deeper into cavern, where solid ice was found, so that "a man can stand on its surface" (Rychkov, 1770, p. 95).

In 1876, I. D. Chersky published the results of explorations and mapping of Nizhneudinskaya Ice Cave (Fig. 1),

located in the Eastern Sayan, including two cavities divided by a talus: Bol'shaya and Malaya (Fig. 6). For the first time, the positions of two glaciers were shown on a map and, noting the beautiful ice stalactites and stalagmites, the researcher proposed the condensation theory of ice cave formation.

The end of the nineteenth century was marked by the publication of the Abigi-dzhe Ice Cave map ("the dwelling of the devil" in the local Tungus language, Fig. 7, Stephanovich, 1896), on which the position of the ice was also represented. Moreover, as it is stated by Ya. V. Stephanovich, in spite of the fact that the cave exploration was carried out on 14 July, near the entrance, he wrote, "The ceiling of the cavity is strewn with the icicle-like stalactites; the bottom is blocked by boulders with hardened ice and thin ice plates" (p. 66).

Discussion

The beginning of the twentieth century, for historical reasons, was characterized by the general absence of interest in caves. But starting in 1958, when the Russian speleological movement was formed, many ice caves were mapped. In comparison with ice cave mapping in Europe, the first map (the vertical profile of Moncodeno Ice Cave) was drawn by N. Stenone around 1671 (Turri et al., 2009). It shows not only the distribution of the ice inside the cavity, but also indicates its morphology. Other ice cave maps, for example, Velika Ledenica in Paradani, were also represented by vertical sections (Kranjc, 2004).

Acknowledgments

This work was supported by the Russian Geographical Society's Atlas of Russian Geographical Explorations and Findings on the Earth grant.

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teoriju formiranja ledenih špilja koje krasi prekrasni stalaktiti i stalagmiti. Krajem 19. stoljeća pojavila se karta ledene špilje Abigi-dzhe ("Vragova kuća" na lokalnom tunguskom jeziku) (sl. 7) (Stefanovič 1896) na kojoj je također prikazan položaj leda. Nadalje, iako je špilja istražena 14. lipnja, Ja. V. Stephanovich tvrdi da se blizu ulaza "na stropu nalaze ledene strukture nalik stalaktitima, a dno je začepljeno kamenjem sa stvrdnutim ledom i tankim ledenim pločama" (str. 66).

Rasprava

Zbog povijesnih razloga na početku 20. stoljeća nije bilo interesa za istraživanjem špilja u Rusiji. No, 1958. osnovan je ruski speleološki pokret i izrađene su karte mnogih ledenih špilja. Za usporedbu s izradom karata ledenih špilja u Europi: prvu kartu, odnosno vertikalni profil ledene špilje Moncodeno izradio je N. Stenone oko 1671. (Turri i dr., 2009), a prikazivala je ne samo razmještaj leda unutar šup-

ljine, već i morfologiju. Druge karte ledenih špilja također su prikazane vertikalnim profilima, npr. Velika ledenica u Paradaniju (Kranjc 2004).

Zahvala

Izradu ovog rada podržalo je Rusko geografsko društvo, projekt Atlas ruskih geografskih istraživanja i pronalazaka na Zemlji.

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