Summary of the geotrip of the IAH Karst Commission to Croatia and Slovenia-May 2023

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The idea of the geotrip is an old tradition of the KC, which started several decades ago. The goal of the geotrip as recognized and familiar to all KC members over the years is to allow curious hydrogeologists of karst environments to be exposed to karst landscapes and phenomena in various regions around the globe.

During May 22-28, 2023, 26 people, some of them members of the KC group, participated in a geotrip that traveled in Croatia and Slovenia. During this 6-day trip, the group visited powerfully flowing springs, spectacular caves, national parks, impressive karst phenomena, and observation points, listened to an evening lecture on springs, visited the Karst Research Institute in Postojna, Slovenia, and enjoyed the peaceful atmosphere of these two Balkan countries, as well as the local food and drinks.

The group included people arrived from 11 countries (5 from Bulgaria, 4 from Croatia, 4 from Slovenia, 4 from Israel, 2 from Serbia, 2 from Romania, 1 from Greece, 1 from England, 1 from Slovakia, 1 from the USA, 1 from Brazil). Of the 26 participants, 11 are women (42%). The KC financially supported one student who joined the geotrip.

The geotrip was successfully organized and guided by the joint effort of two teams: a Croatian team led by Josip Terzić from the Croatian Geological Survey, and a Slovenian team led by Nataša Ravbar from the Karst Research Institute in Postojna, Slovenia, with administrative assistance of Avi Burg who is the current in-charge-chairman of KC. The Croatian team also included Marina Filipović, Ivana Boljat and Ana Selak, and the Slovenian team included Blaž Kogovšek, Ciryl Mayaud, Uroš Novak, Franci Gabrovšek, Matej Blatnik and Metka Petrič.

We thank the Croatian and Slovenian teams for the interesting and comprehensive program, the strict organization, and the professional guidance in the field.

Here is the geotrip route on a Google map:



Below are photos of the most impressive sites the group visited during the 6 days:

<u>Jadro Spring near Split</u>: Jadro Spring is a typical karst spring with a mean daily discharge of 9.51 m³/s. The spring supplies water to the city of Split and its surrounding municipalities and was also of great importance to the development of two Roman settlements: Salona and the palace of Emperor Diocletian.

The group benefits from a professional explanation of the site and its importance given by the local experts.



The Blue (Modro) and the Red (Crveno) lakes in Imotski: These two amazing lakes found in deep karstic collapses are located 550 m apart, and are extraordinary karst phenomena in a complex system of sinking, loss and underground transboundary relationships of karst rivers, lakes and aquifers in the central part of the Dinaric mountains. The width of the blue lake is 230x90 m and it is more accessible for visits than the Red lake. Red lake is the deepest (528 m) known case of a collapsed doline containing a lake. The collapse diameter on the surface is 350 m.

The group visited both impressive lakes and the first group photo was taken near the Red Lake.



<u>Krčić waterfall</u>: the 22 m high waterfall is located near the city of Knin, where several tributaries join to form the magnificent Krka River. Krčić is one of the largest and most powerful waterfalls in Croatia. The Krčić waterfall almost dries up during summer.

The group's visit to the waterfall was after a period of heavy rain, so the flow was powerful and noisy. A few brave members of the group walked on the small wooden bridge crosses the first meters of the Krka River and received a shower of water from the strong spray of the falls.



<u>Plitvice lakes</u>: A series of 16 lakes with a distinctive blue-green color, stretching for 8 km, and fed by many small streams descending from the mountains. The lakes spill over into each other in foaming cascades and thundering waterfalls separated by natural dams made of tufa. The tufa barriers grow at the average rate of ~1cm per year. Plitvice National Park has been on the UNESCO World Heritage list since 1979. The lakes are topographically divided into an upper group and a lower group by a large fault.

The group enjoyed a full day in this fascinating NP, and the clear blue sky added to the wonderful tour experience. As the visit was after a period of heavy rains the water flow was strong, so part of the NP was inaccessible due to flooding.





<u>Paklenica NP</u>: Paklenica NP (since 1949) includes the highest peaks of Velebit Mountain. The area has an abundance of geomorphological phenomena and forms, an attractive landscape, fascinating nature as well a diversity of flora and fauna. Paklenica is well known for its two canyons - Velika Paklenica and Mala Paklenica. The NP is the most visited climbing center in Croatia, which is also popular outside Croatia.

The group's visit to the NP began with guidance and explanations from one of the local staff, including in the modern and interactive visitor center, and continued

as a free-time experience during which everyone decided how to spend his time in the park. Most people climbed up the valley to enjoy the route and the water flow upstream and to be impressed by the deep canyon and the high limestone cliffs.



<u>Vrana Lake</u>: The largest lake in Croatia, which in 1999 was declared, along with its surrounding, as a natural park to protect it. The area near the lake is of economic value due to its fertile soil. During the 18th century, the digging of an 850 m long canal that connected the lake to the Adriatic Sea has changed the lake's natural fluctuations. The lake is part of a complex hydrological system in which the inflow is from surface flows and a series of karstic springs located mostly along its northern shore.

We didn't visit Varna Lake itself but watched it from a spectacular viewpoint called Vidikovac Kamenjak. This observation point is located on the northern side of Lake Vrana, at an altitude of 283 meters above sea level, from where Vrana Lake and the islands of the Zadar, Šibenik and Kornati archipelago are clearly visible. At the observation point, there are beautiful karst surface phenomena.







Postojenska Jama, Planinska Jama, Škocjanske Jama : A major part of the geotrip in Slovenia was focused on visiting the impressive caves in the area near Postojna. All the caves are located at the Ljubljanica River recharge area, which is rich in karstic phenomena, some of them developed along tectonic lines. The first visit of the group was to Postojenska Jama, which is also the most touristic of the three. The cave is important and famous because of its natural features, 200 years of tourist development and especially because of the world's first ever scientific research in a cave. In this cave, which is 25 km long, the first cave-dwelling animals in the world were discovered in this cave. Planinska Jama is a large spring cave 6.6 km long and consists mostly of large active river passages with crosssections often larger than 100 m². There are considerable annual differences in water contributions into the cave as well as inflow velocities. The 5.8 km long Škocjanske Jama is part of the river Reka course, floods usually reach a height of up to 30 m. The cave was included in UNESCO's World Heritage list in 1986. This cave also serves as a test site for continuous recording of gravity and its response to floods.

The group enjoyed visiting these three different caves, each with different characteristics and beauty. Nataša and the Slovenian team gave in each of them a professional and detailed geological and hydrological explanation. The Planinska cave is dark, so the group had to equip with helmets and flashlights. We also tried to see the Proteus anguinus, a blind cave-dwelling amphibian, in the water but failed.

Postojenska Jama:



<u>Planinska Jama:</u>











<u>Škocjanske Jama:</u>













<u>Rakov Škocjan</u>: Rakov Škocjan is a karst valley formed when the ceiling of a karst cave began to sink and then collapsed. Downstream the valley narrows and the stream is crossing an impressive natural bridge called Veliki Naravni Most (big natural bridge). Its width is 15-23 m, its height is 37 m, and its length is 56 m. During intense floods, large parts of the valley are inundated, and the water level rises as much as the height of the bridge arch.

The group went down to the valley, where received a detailed explanation of the geological history of the valley and the current situation, and observed the magnificent natural bridge.







<u>The Karst Research Institute in Postojna (ZRC SAZU)</u>: The institute is one of the most recognized karstological centers in the world. The institute's researchers come from various backgrounds including geology, geography, physics, chemistry, biology and microbiology, thus enabling a multidisciplinary approach. The research includes field studies, laboratory investigations and numerical modeling. The institute hosts a karstological library, one of the most complete of its kind, a laboratory specializing in water chemistry and a geological laboratory. The Institute is housed in an ancient building, built at the end of the 17th century that became the home of the Karst Research Institute in 1951.

The group visited the institute, was welcomed by the director, and received an explanation from Nataša about the current activities as well as the interesting history of the building. The group also visited the library and the laboratories and were also impressed by the explanation about the karst cave archive that is officially kept at the institute.

In the evening, the group gathered in the institute's lecture hall and heard an interesting one-hour professional lecture given by Abe Springer entitled "What are springs?"











Good food, drinks and a friendly atmosphere (and even a quality free jazz show in one evening) were also an important part of the geotrip and its success, as can be seen in the photos below:







