# Ravne 3 Tunnels
## Oldest Structure of the World

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## Introduction

Exciting new discovery is in front of us. A location that has never been recognized as a potential archaeological site. Nobody knew anything about it in the past. Until our research team came.

This book brings reports from our field geologist Richard Hoyle, field archaeologist Amna Agić, photographs from our senior guide Haris Delibašić and myself. It's a story of discovery, digging, artifact-finding process, dating and volunteering. It's a perfect example how discovery is done and history of humanity changes.

Enjoy.

Dr Sam Osmanagich
Principal Investigator of the Bosnian Pyramid Project

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# DATING OF 'RAVNE 3' TUNNEL

## Dr Sam Osmanagich

In July 2018, I bought a parcel of land with the surface area of 5,141 m2 in Visoko, adjacent to our Ravne 2 Park, on the western side, identifed in the cadaster as 'Džanova strana'. It is a steep slope, covered in scruffy vegetation, a thicket, and it was filed as 'Forest, Class IV'.

I had reserved this parcel as early as July 2017, because I considered it important, as it borders the park, but also because of a detail I noticed when visiting the site. It was a conglomerate rock that protruded from the earth, which resembled conglomerate concrete found at the entrance to the prehistoric Ravne Underground Labyrinth.

After the purchase was completed, we sent the workers to clear the land and build a dirt road on the parcel's northern boundary. We built earthen staircase from the park. I was very satisfied after the surveyor marked parcel's upper boundary precisely. Multiple conglomerate rocks emerged on our parcel. The excavator revealed such rocks in five places.

Additional work of the excavator, following my instructions, showed that, in four spots, we could reach narrow passages from which one could sense streams of cold air. It was clear to me: underneath those rocks, there are entrances to underground tunnels.

I called Richard Hoyle, our field geologist, from England, and told him:

> - 'Richard, I would like to ask you to determine the altitude of the entrance to the Ravne Underground Labyrinth, entrance to the Healing Tunnels underneath the Air Spa, entrance to the Orgon Chamber at the Bell Tower Hill, and the entrances to these possible tunnels. This is likely the same network of tunnels as the Ravne tunnels. At the time the last Ice Age ended, 12,000 years ago, a powerful tidal wave came from the north, tore off a portion of the plate and wrecked some of the tunnel network. That wrecked section now lies below and constitutes what we call 'Ravne 2' Park. Once upon a time, this valley had not been here, and in its place stood a conglomerate plate covering tunnels.'

Richard measured the altitudes and informed me that all these points were on approximately the same elevation +/- 4 meters. This only confirmed my original assumption

In August 2018, under Richard's supervision, I gave our volunteers an opportunity to start clearing material around and underneath conglomerate rocks. At first glance, this material appeared to have originated as natural sediment, with a common stratigraphy: humus levels of different age (dark and light-colored), as well as a varied age of clay (light, dark, grey). Most geologists and archaeologists would have probably instantly discarded any thought that anything might lay beneath this ancient, compact clay. It takes tens of thousands of years for grey clay to form.

After they toiled for a couple of weeks, at my prodding, in late August the volunteers finally cleared a path, discovered a narrow passage and managed to crawl several meters in. Ahead, they came across a chamber. They kept excavating and, beyond some clay type material, they uncovered a rock laid over some smaller plates. It had clearly been erected there to block the entrance to the tunnels. That was an important moment. We uncovered evidence of anthropogenic action.

At that time, I decided to cease excavation in that location, which we marked as C2 (Entrance no. 2). We left this rock as an archaeological evidence of human action and we switched to C3. Several days later, we penetrated to the segment wide enough to allow us to enter.

Over the course of several expeditions, which involved Richard, Sue, Stefan, Marie-Sophie, Ajdin and others, we established the existence of several tunnel directions, with galleries broader than those in the Ravne tunnels. The two major axes were east-west (through the hill, underneath the urban area of Dubrave), but also north-south, parallel with the Ravne tunnels.

The east-west direction allowed us to uncover 65 meters of traversable passages, with clear evidence that these cavities had been used in various past eras. The ceramic remains most likely come from the Middle Ages (which is also the view of our colleagues from the Visoko Homeland Museum), while the several iron artefacts most probably originated at the age of Ancient Rome, as many as 2,000 years ago.

In the central section of the east-west axis, in several places we encountered stalactites hanging from the ceiling, as well as stalagmites, which precipitated on the floor. I considered them to be an exceptionally important find. I recalled the experience of the stalagmites we discovered long ago, in one of the Ravne entrance tunnels. I had learnt then that stalagmites can be dated. By the way, the age of the stalagmites at the entrance to the Ravne tunnel was around 5,000 years. They were created after the ceiling had collapsed. At the time, I was told that, typically, it takes a very long time for the base preparation.

As we had a number of stalagmites on the floor, I was confident that we would not run out of them. And, secondly, that the dating we were going to obtain would be auspicious.

I instructed Richard to prepare a sample and to contact the Florida dating laboratory. After three days of slow cutting with small saws, he cut, prepared and sent it to Florida, as per the website instructions. The very same day, upon his return from the post office, he received a letter from Italy, from the European representative of the Florida laboratory (Ms. Claudia Arigoni from Beta Lab Services), in which she informed him that 'they do not conduct analysis for projects that are not recognized by the international scientific community' (?). Richard was shocked by this flagrant discrimination. I was not.

This was not the first instance that we had unpleasant experience with radiocarbon dating laboratories. As the forms require the designation of the project ('Bosnian Pyramids' Project), the sender ('Archaeological Park: Bosnian Pyramid of the Sun' Foundation) and why it matters ('minimum age of a tunnel network'), it was clear that the findings of scientific laboratories would confirm the exceptional age of the pyramid complex in Visoko. That is a political issue for them.

In 2007, we experienced a clear example of politicization in science, when we sent the pieces of wood found in the Ravne tunnels to the address of three radiocarbon dating laboratories: Gliwice in Poland, Kiel in Germany and Oxford in the U.K. The retrieved piece of wood we split into six equal segments, sent two to each of these three addressed and documented everything.

The first results we received from Germany. The sample was dated as 32,000 years old. Next we received the analysis from Poland, dated to between 30,000-34,000 years. Evidently, both confirmed that the wood was older than 30,000 years. The English never responded, and when I intervened, they claimed that the sample was not organic, expecting that they were the only ones to have received the sample. Then I sent them all the documents with the findings of other laboratories and I positively established that the sample in question was organic material. The ‘superior’ English were taken aback. Then, they ineptly tried to cover they politicking by claims that their equipment had not been functional, then that their staff ‘accidentally’ burnt both wood samples…

Afterwards, we have never again used this laboratory in U.K, a typical example of elitist, politicized science.

Why did this dating matter? This chunk of wood had been trapped in a conglomerate found over our ceramic blocks in the Ravne tunnels. Therefore, these blocks had been made more than 32,000 years ago. Someone had a high-temperature manufacturing technology tens of thousands of years before conventional experts expected it. And where, at the heart of tiny Bosnia.

The history repeats itself. The Italian lady knew that we operate the greatest archaeological discovery on the Planet, but it is not the elites that control the process, but the independent, non-profit, non-governmental Foundation.

However, there are more than a hundred radiocarbon dating laboratories in the world, and there are no more monopolies. It is just another scientific service, as so many others. Truth cannot be contained, not can knowledge and information be manipulated, as once they had been.

The samples found in the new tunnels, which we designated ‘Ravne 3’, we sent to Kiev, Ukraine. We received the results very promptly. Several of the samples were dated between 2,500-10,500 years and these told us that these cavities were quite old and that they had been in use for a very long time.

In Kiev, our stalagmite sample was prepared following the standard scientific methodology. The stalagmite-s cross-section was divided in three parts. The outer was most recent, created from water dropping from the ceiling. The first, oldest, core layer was created when the base for the creation of the stalagmite (dry matter, dust and various other particles) was developed. A total of 20 grams and 1.5 cm of the thickness of that core were prepared for dating.

Through an application of the vacuum pyrolysis protocol (thermal destruction), an adequate quantity of carbon was obtained. Mixing it with lithium yielded lithium-carbide, then acetylene and benzene. Then the C14 radiocarbon isotope method could be applied to 1.0192 grams of the hydrocarbon benzene ($C_6H_6$) obtained in this fashion. Now we are on the path to determine the age of the stalagmite's core.

The result of the dating was fantastic: 26,200 +/- 200 years!

So, radiocarbon dating indicated the age over 26,000 years. What is the actual age of this stalagmite?

First, when mechanically removing the stalagmite from the floor of the 'Ravne 3' tunnels, Richard did not cut to the very base. Around 1 cm of the stalagmite, essentially the oldest part, remained.

Second, calibrated age is typically 15% greater than radiocarbon age. However, as a fully precise method of dating organic material does not exist, a variance of several per cent or more is always to be expected.

Third, it takes time for the base to be naturally prepared for creation of stalagmites. This can take thousands of years.

In view of these three observations, a logical conclusion is that the actual minimum age of the stalagmite is between 30,000-35,000 years. The 'Ravne 3' tunnels are not just cavities, and they exhibit traces of shaping. Consequently, it is a tunnel network of exceptional age.

This takes us back to the time when the pyramid complex in Bosnia was constructed. I wish to remind you that the age of the organic material, fossilized leaves found between concrete blocks on the Bosnian Pyramid of the Sun is 29,200 +/- 400 years. American astrophysicist Dr. Paul LaViolette estimated the calibrated age of the pyramid at 33,600 years.

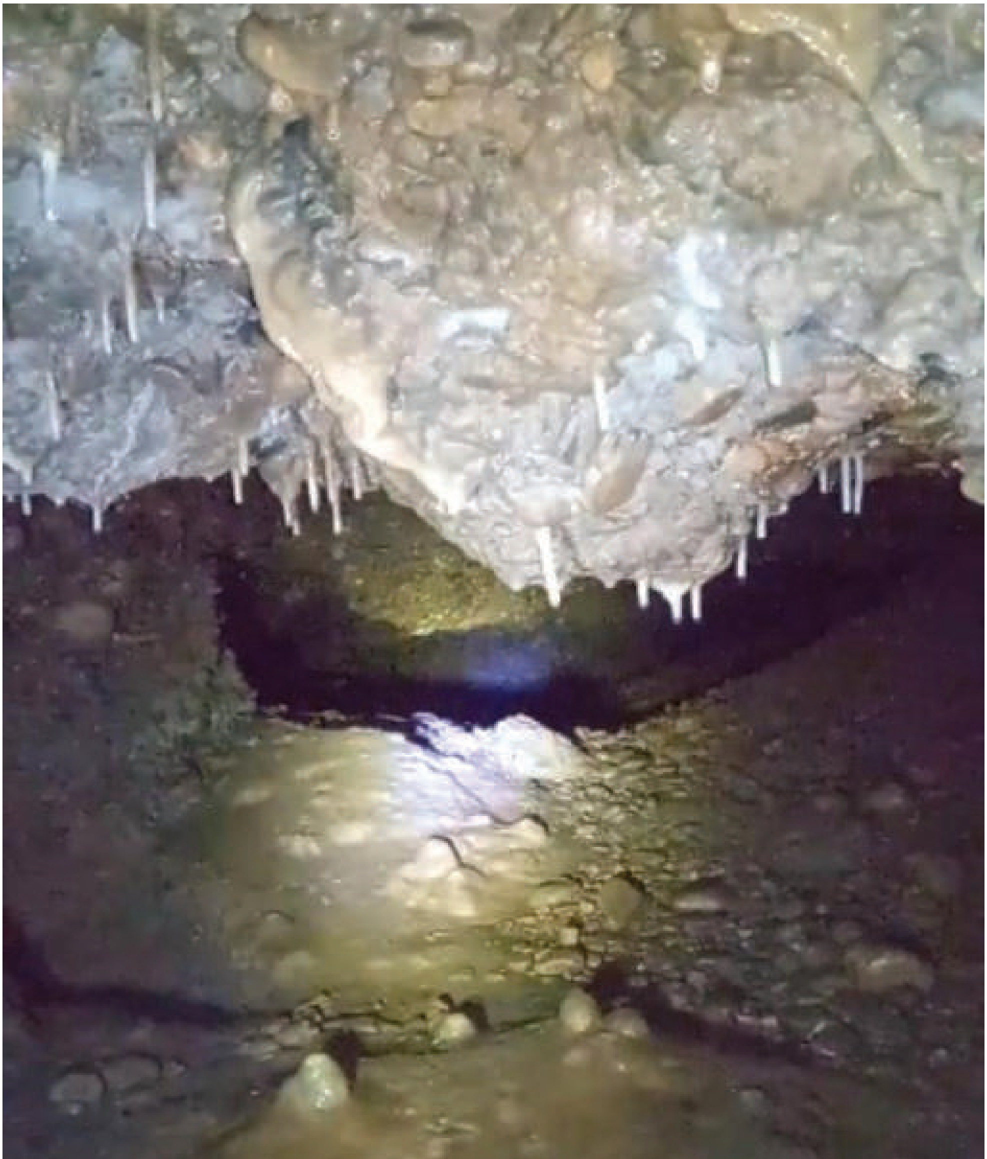
We commenced clearing the 'Ravne 3' tunnels, which run along the north-south axis. They are parallel with the Ravne tunnels, although 200 meters apart. There is no doubt in my mind that, after several hundred meters, these tunnels will converge and continue towards the Bosnian Pyramid of the Sun.

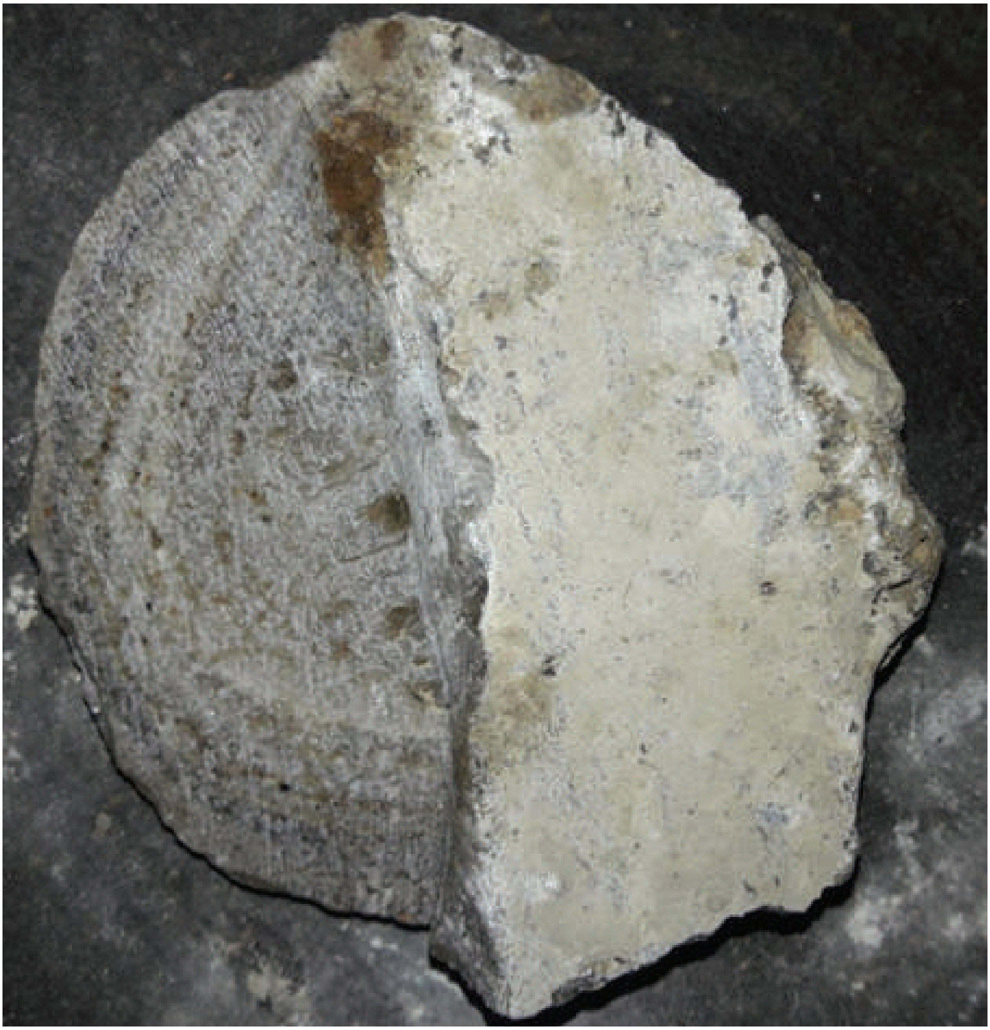
That is our goal, to arrive underneath this largest and oldest of the world pyramids, despite the attacks of the cultural establishment from Bosnia and the entire world, which we experienced over the past 13 years. The fight for scientific truth is far nobler than bending your back to 'authority'.

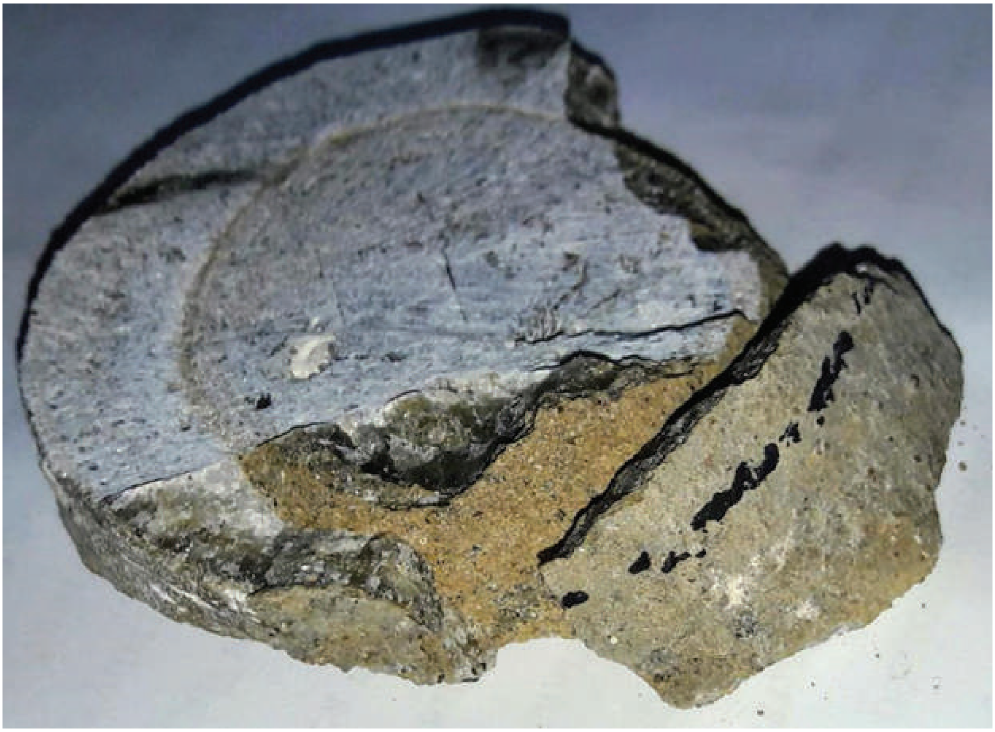
Unlike in the early years, 2005 and 2006, when the power of officialdom and 'expert' authorities had been used in the attempt to stop us, nowadays we are in position to have all scientific arguments on our side. And there are more and more of them every day.

Tens of thousands of visitors to the Bosnian pyramids have become aware that history is not what we had been taught. In time, new history textbooks will recognize this.

And from the Spring of 2019, our volunteers from all over the world will again, under the guidance of experts, be given an opportunity to become part of the discovery of the most exciting project in the world.







HISTORIC USE OF CIRCUMSCRIBED EQUILATERAL TRIANGLE

## Радіовуглецева дата (Radiocarbon date)

| | | |
|---|---|---|
| Замовник (Customer) | Foundation "Archaeological park | "Bosnian Pyramid of the Sun" |
| Зразок(Sample): | Sample S001 (layer B, top) | (carbonate) |
| Код лабораторії (lab code) | IHME-3734 | |
| Маса бензолу (benzene mass) | 1,0192 | грам (g) |
| Час вимірювання (counting time) | 3000 | хвилин (minutes) |
| Швидкість лічення проби (Sample count rate) | 0.87 | CPM |
| Фон (імп./хв.) (Background count rate) | 0.506 | CPM |
| Ефективність реєстрації (counting efficiency) : | 73,51% | Процент (percent) |
| Радіовуглецева дата (Radiocarbon date) | **26200 ± 250** | **BP** |
| Калібрована дата (Calibrated date) | - | |

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12.11.2018

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# Geoarchaeological Summary Report

## Ravne3 Tunnels Excavation Visoko, Bosnian Valley of the Pyramids 2018/2019

By Richard Hoyle
'Bosnian Pyramid of the Sun Foundation' Field Geologist

FONDACIJA ARHEOLOŠKI PARK:
BOSANSKA PIRAMIDA SUNCA
SARAJEVO, BOSNA I HERCEGOVINA
THE ARCHAEOLOGICAL PARK:
BOSNIAN PYRAMID OF THE SUN FOUNDATION
SARAJEVO, BOSNIA AND HERZEGOVINA

**Acknowledgements;**
Dr Sam Osmanagić – Principle Investigator
Musa Bajić– Foundation Site Supervisor
Amna Agić – Foundation Field Archaeologist
Marie-Sophie Gristi – Volunteer Coordinator

**Thanks;**
Ajdin Ahmetspahić - Foundation Guide Coordinator
Evelina Čehajić – Ravne Park Events Coordinator
To all of the Foundation Board of Directors,
guides & work crew members

**Special Thanks;**
To all of the volunteers who partook in the
2018/19 Ravne3 Tunnels excavations

**Bosnian Pyramid of the Sun Foundation**

**Ravne3 Tunnels Excavation – 2018/19**

The initial excavation at site Ravne3 began in July of 2018 and was conducted by an international team of volunteers under the supervision of project leader, anthropologist Dr Sam Osmanagić (B&H), field coordinator Marie-Sophie Gristi (Fr), field geologist Richard Hoyle (GB) and later, field archaeologist Amna Agić (B&H).

The Ravne3 excavation site is situated on the outskirts of Visoko, 200 metres west from the entrance to the original Ravne Tunnels. The two sites are situated on opposing sides of a small 30-metre-tall north-south trending valley, with the Ravne2 Park sitting on a gently sloping flood-plain between the two valley sides.

The excavations at Ravne3 revealed extensive passages and chambers that cut through a loosely consolidated gravel bed in a similar fashion to the nearby Ravne Tunnels, first discovered and excavated by Dr Osmanagić in 2006.

Evidence of anthropogenic activity at site Ravne3, besides the existence of the tunnels themselves and the fact they have been intentionally blocked up with loose debris, include tool markings, drywalls, lithic & metallic artefacts and over 3000 pieces of ceramics belonging to several different archaeological periods.

Approximate dating of the cavity spaces at Ravne3 was made possible by the removal and subsequent U-Th content analysis of a small stalagmite. An absolute minimum age of 5900 years ± 300 was given.


Ravne3 Site Location
Western outskirts of City of Visoko, Central Bosnia
Lat/Long coordinates; 43°59'45.49"N 18° 9'27.06"E
25 km northwest of Sarajevo
2.0 km west of Visoko centre
2.6 km northwest of Bosnian Pyramid of the Sun.

Figure 1; Satellite imagery of hilly terrain between Sarajevo and Visoko.
Insert; Map of Bosnia & Herzegovina and its neighbours.

**Geography of Visoko & Ravne3 site**

Visoko City is located on a floodplain within a large northwest-southeast trending valley formed between foothills of the Dinaric Alps massif. The Bosnian Capital, Sarajevo, located 25km away from Visoko, is at the southeast end of the valley. Zenica, a large industrial city, is at the northwest end of the valley, 30km away from Visoko. The hilly-mountainous relief of central Bosnia surrounding the large valley rises from the north towards the south. Visoko city centre is located 423m above sea level and the surrounding hills have peaks with altitudes between 500m a.s.l to over 1000m a.s.l. and are covered by deciduous forest vegetation. Along the Sarajevo-Zenica valley floor runs the River Bosna, the namesake of Bosnia and the third longest river in the country. Visoko has been built at the point of confluence between the r.Bosna and one of its major tributaries, the River Fojnica. Visoko has a four-season humid-continental climate (Dfb), with warm summers and precipitation spread evenly throughout the year. The average annual rainfall is 1,958 millimetres, the wettest month being February, with an average of 249 mm of precipitation. The driest month is August, with 78 mm of precipitation. The annual average temperature of the area is 9 ° C. The warmest month is July, when the average temperature is 21 ° C, and the coldest being December, with -5 ° C. *(NASA Earth Observations NASA/MODIS. Hydrology and Earth System Sciences, Peel, MC., Finlayson, BL., McMahon, TA., 2007)*

Photo 1; The City of Visoko is situated on part of the floodplain within the Sarajevo-Zenica Valley. The Bosnian Pyramid of the Sun, seen overlooking the city, is 2.5 km southeast of the Ravne Tunnels Complex.

Stijenska Gora, at 849 m a.s.l. is the tallest peak in proximity to Visoko and is 4.5 km south-west from the city. The mountain is part of a small group of hills that rise from the southwest side of the Sarajevo- Zenica valley, where Visoko is situated. The Bosnian Pyramid of the Sun, the closest topographic highpoint to Visoko's urban centre, is moulded into the north-eastern extent of these hills (photo 1). Water draining from this group of hills and pyramidal structures form streams that head northeast towards the r.Bosna, incising valleys through the topography. Ravne, Ravne2 Park and the Ravne3 excavation site are located at one of these small north-south trending valleys, which terminates at the margin of the Sarajevo-Zenica floodplain (photo 2, figure 2).

Photo 2; Ravne2 Park occupies the low ground between the east and west sides of a small valley. Climbing steps towards Ravne3 excavation site seen centre-left. Looking north.

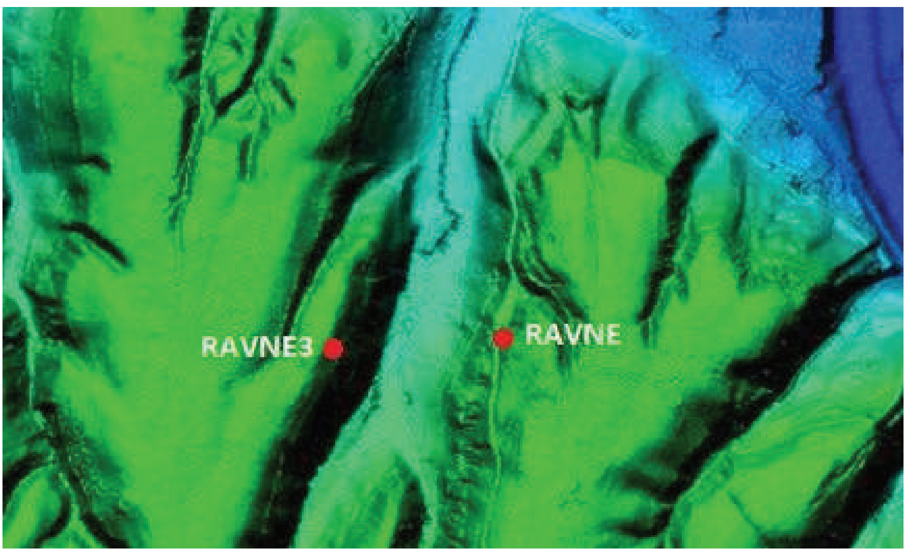



Figure 2; LiDAR imagery of north-south trending Ravne Valley with Ravne & Ravne3 tunnel entrances marked, east and west respectively. Distance between the entrances is approx. 200 m.

**Geological context**

The Sarajevo-Zenica valley in which Visoko is situated is what remains from a large intermontane lake that existed until the end of the Miocene epoch, 5.3 million years ago (Figure 3). During the existence of the lake the region saw intensive periods of geological instability as the Dinaric Alpine mountains were being formed, beginning at around the Oligo – Miocene boundary (23 Ma). This period of uplift brought large amounts of sediment into the Sarajevo-Zenica basin producing units collectively named as the “Lašva series”. Alternating layers of fine-grained carbonaceous clays were washed into the lake and deposited during geologically quiet periods and courser grained sands and gravels deposited during periods of increased uplift where rates of erosion were greatly intensified. (Pavelić, D., The southwestern boundary of Central Paratethys, 2002. Milojević, R., Geološki sastav i tektonski sklop Srednjebosanskog basena, 1964)

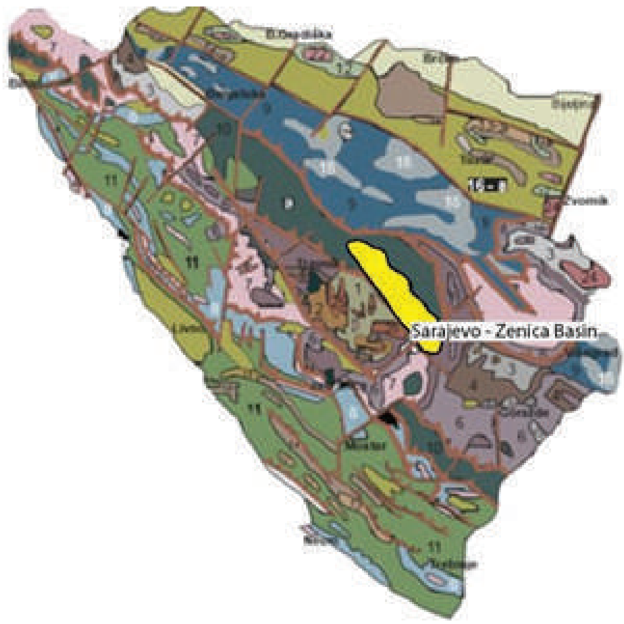



Figure 3; Geological map of Bosnia & Herzegovina with Miocene Sarajevo- Zenica basin highlighted. Adapted from Geological Guidebook of Bosnia, Hazim Hrvatović, 2006

Surrounding the Sarajevo-Zenica basin are geological units represented by a multitude of facies, owed to by a tectonically complex history involving many turbulent phases of shifting plates and mountain building episodes (Figure 4).

**Palaeozoic**

South West from Visoko the landscape is composed of geology belonging to that of Silurian-Devonian (S, D), Devonian (D), Permian (P) and the Permian Triassic (P,T). These periods contain units of;
(S,D) Greenschist, shale, quartzite and marble
(D) Philite, quartz-sericite schist, quartzite, quartz-porphyre, dolomite, limestone and marble.
(P) Conglomerate, sandstone, shale. (P,T) Shaley limestone with marl.

**Mezosoic**

North East from Visoko the landscape is composed of a complex array of geological units belonging to that of lower Triassic (T1), middle Triassic (T2), upper Triassic (T3), Jurassic (J), Jurassic Cretaceous (J, K) and upper Cretaceous (K2). The units represented are;
(T1) Sandstone, schist, marl and limestone (T2) Anisian limestone and dolomite
(T3) Microsparite
(J) Ophiolite
(J, K) Flysch sequences
(K2) Carbonate flysch - limestone, breccia, pelite and marl.

**Cainozoic**

This era is represented by deposition within the Sarajevo-Zenica basin within which Visoko town is situated, composing of Oligocene Miocene (Ol, M), Miocene (M), Pliocene (Pl) and Pliocene- Quaternary units (Pl, Q) with Quaternary (Q) surface covers along the banks of river courses. The units this final period is composed of are;
(Ol, M) Conglomerate, sandstone, marl, clay and travertine limestone.
(M) Conglomerate, sandstone, clay, marl, limestone and distributions of coal.
(Pl) Sand, gravel, clay and coal.
(Pl, Q) As above (Pl) but without coal deposits.
(Q) River detritus, sand-clay.

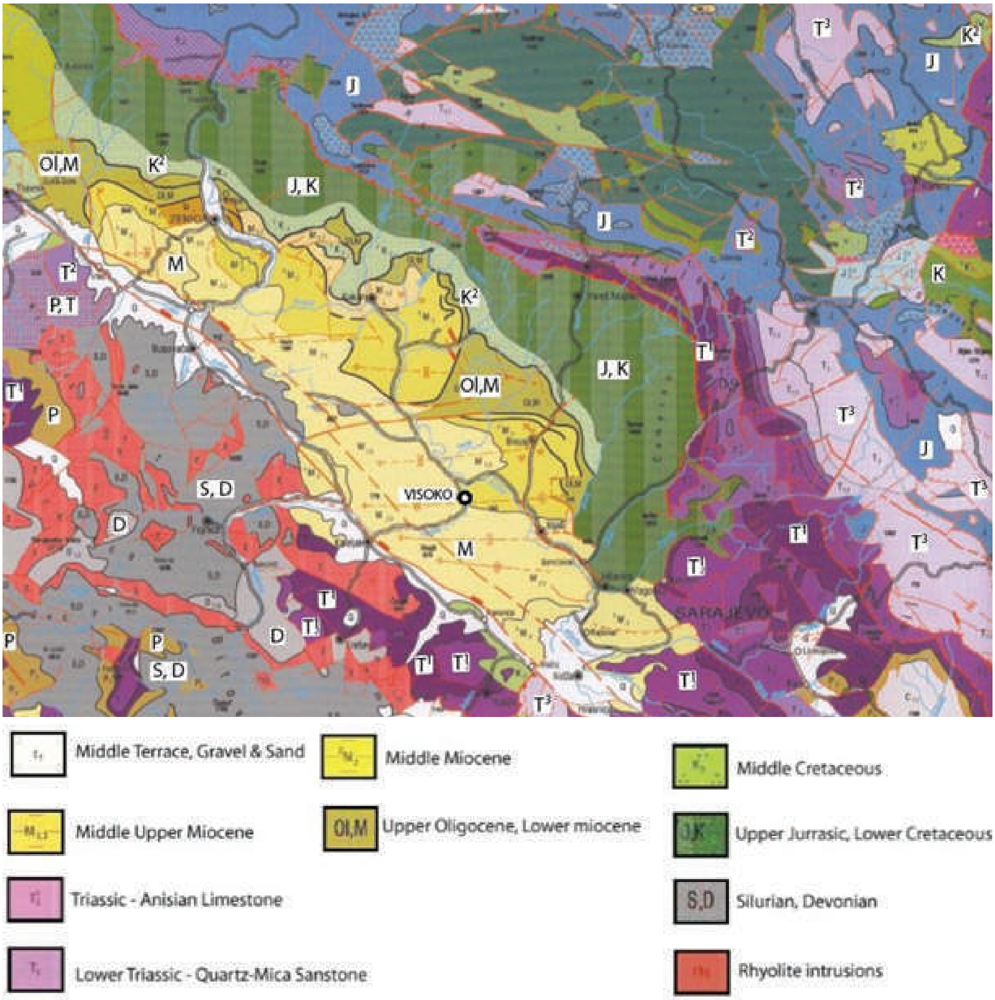



Figure 4; Geological map of the NW-SE trending Sarajevo-Zenica intramountain Basin and surrounding units. Source; Geological map of Bosnia and Herzegovina at 1:300 000, Earth Sciences Institute of Sarajevo, 2002; Text of 1:300 000 map, Cicic S., 2002

## Local geology at Ravne Valley

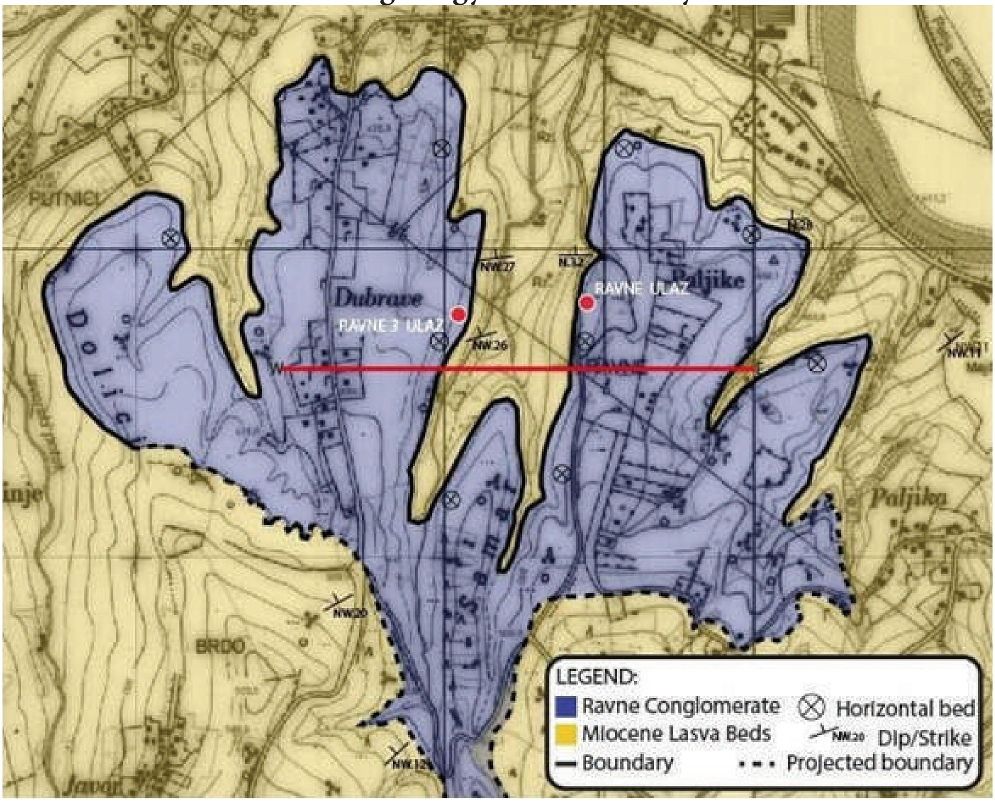



Figure 5; Geological map of Ravne locality, Visoko, Bosnia. Scale; 1:10,000

The oldest exposed rock units exposed at Ravne belong to the Middle-Upper Miocene (M2,3) Lašva- series beds (figures 5, 6, 7). These lacustrine sediments dip north/north-west at approximately 28 degrees with the younger sheeted Ravne conglomerate unit resting above. At the boundary between the two rock units is a sharp erosional surface and an angular unconformity. Downcutting by the Ravne conglomerate is minimal.

Within the Lašva-series strata at Ravne, marl beds dominate and range in thickness between 5-30 cm and are composed of thin sub-layers ranging between 2 mm to 1 cm. Subordinate to the marl are medium to coarse grain sized calcareous yellow sandstone beds that range in thickness between 10- 40 cm.

Sublayers within the marl beds comprise of oligomictic gravel beds composed of floating granule grade clasts within a yellow coarse calcareous sand matrix and range in thickness between 10-30 cm. Dark oxide-red fine-grainsized ironstone beds are the least common sublayer composition within the marls and are seen no more than 2 cm thick, laminated or occasionally bearing ironstone concretions containing yellow calcareous sand. Bed boundaries within the Lašva-series are concordant non- erosional and sharp (figure 7).

The youngest rock unit at Ravne is the Ravne conglomerate (figures 5, 6, 7). This rock unit is generally very coarse and poorly sorted, containing sub-angular to sub-rounded clasts ranging in size from granules up to boulders with an immature coarse calcareous quartz-sand matrix containing clays, silts and lithic fragments. The bed is poorly consolidated, with little to no calcite cement holding the clasts and matrix together (photo 3). Tunnels through the deposit show the rock to be more well consolidated towards its exterior than within its interior, giving the rock unit a sturdy, calcified outer shell. The Ravne conglomerate is an alluvial fan debris flow deposit located at the basin margin, near the base of the hilly terrain. The rock is composed of exotic clasts eroded from the mountains adjacent to the Sarajevo-Zenica basin. Limestone, dolostone, mudstone and sandstone sub-rounded pebbles dominate with subordinate meta-clasts. Igneous, breccia, conglomerate and milky vein- quartz clasts are present but uncommon. There are no minerals/ores of economic importance

**Geological Cross-section of Ravne Valley**

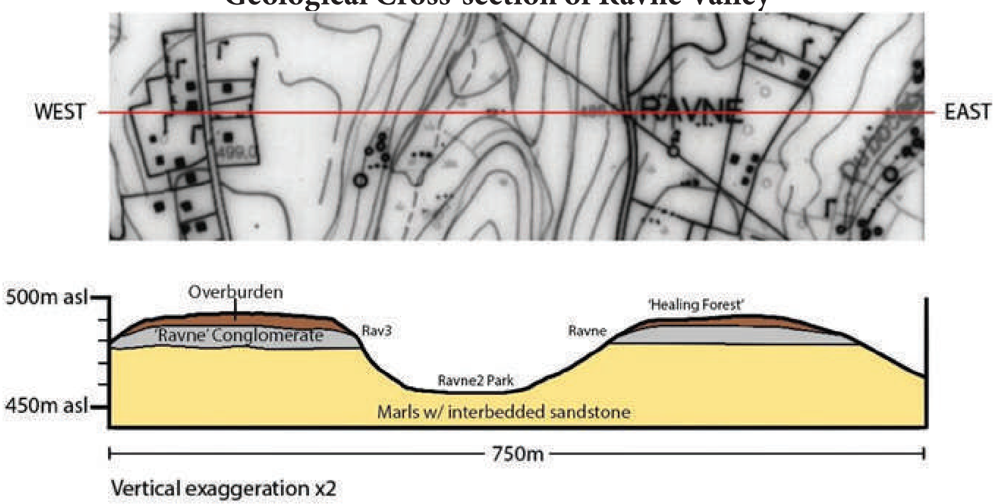



Figure 6; E-W geological cross section of Ravne Valley showing Ravne conglomerate formation resting above Miocene sediments. The Ravne conglomerate is bedded approximately horizontal while the Miocene sediments dip towards the north and north-west, producing an angular unconformity between the two units.

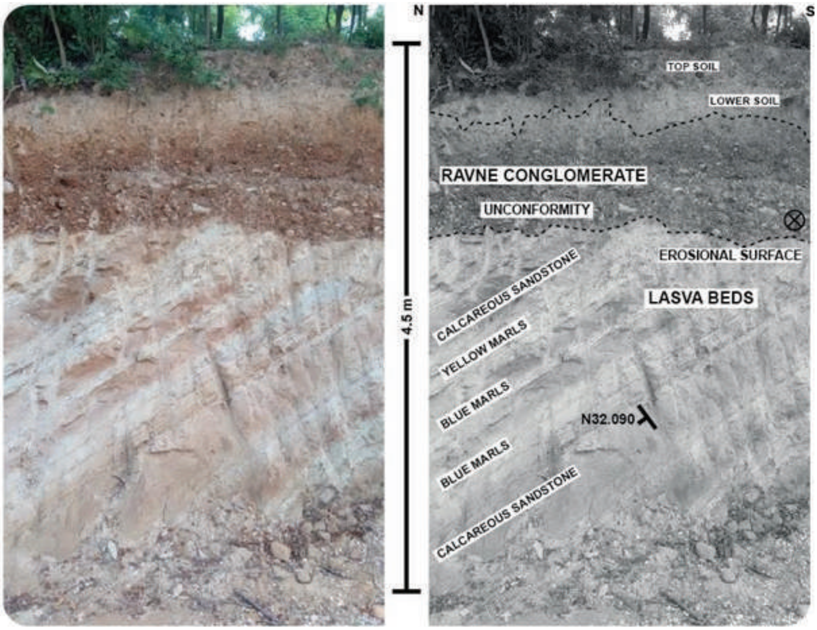



Figure 7; N-S cross section at road cutting near Ravne. Northerly dipping yellow and blue marls interbedded with iron-bearing mudstones, granule grade paraconglomerate beds and medium to coarse grain size calcareous yellow sandstones. The erosional surface between the sheeted Ravne conglomerate above and the Lašva beds below represents an angular unconformity, indicating a significant hiatus in deposition.


Photo 3; Image shows poorly consolidated Ravne conglomerate as seen from the interior of the deposit. Clasts are chaotic and poorly sorted, showing crude and diffuse bedding with high lateral variability.

## Hydrological considerations

Today, the sheeted Ravne conglomerate bed provides the surrounding local village settlements with a reliable and easily accessible ground water-source. Coarse clast size, poorly consolidated, often lacking a substantial interstitial cement, the bed has high intergranular porosity with a high permeability. Recharge of the conglomerate aquifer is predominantly received indirectly from precipitation infiltrating the covering ground and directly where the Ravne conglomerate is exposed to the surface. Mountain- front recharge may also occur where small streams at higher elevation to the Ravne conglomerate exit their channels and flow across the surface of the alluvial fan, infiltrating the permeable conglomerate bed. Water exiting the conglomerate aquifer form springs raised from the valley floor due to the partially saturated conglomerate resting above impermeable marls and slowly permeable interbedded sandstones. The springs are found on the easterly sides of the local incising valleys due to the underlying restrictive beds having a north to north-westerly dip. The springs form through-flowing streams that run along the floor of the small valleys which eventually connect with the River Bosna in the larger principle Sarajevo-Zenica basin. The Ravne conglomerate therefore may be defined as an unconfined perched aquifer that is located within an open basin.

## Purpose of Ravne3 excavation

The Prehistoric Ravne Tunnels first discovered by anthropologist Dr Sam Osmanagić in 2006 have been under continuous excavation since that time (photo 4). To date approximately 2250m of underground passages have been excavated and explored. Rich in archaeological material, over 50 drywalls have been discovered along the main passageway with accompanying in-filled side tunnels yet to be excavated (photo 5). Inside the tunnels large megalithic blocks (K1, K2, K3) have also been identified (photo 6).

Reconnaissance of the the surrounding area on the opposing side of the valley at Ravne was undertaken in order to geologically map the Ravne conglomerate. When small openings were identified beneath the conglomerate rock unit it was considered important to clarify if they were leading to tunnels similar to or directly related to the Ravne tunnels, 200m northeast (photo 8).

The principle goal of the ongoing excavations across the Ravne Tunnels Complex is to identify possible routes allowing subterranean access to the Bosnian Pyramid of the Sun, which is approximately 2.5km south-east of the Ravne Tunnels entrance (figure 8). The secondary aim specifically at Ravne3 was to potentially quantify the lateral extent of the Ravne Tunnels Complex. After the initial opening of the Ravne3 Tunnels were completed a third line of enquiry, and perhaps why Ravne 3 is so significant, began. The investigation would turn its focus to the collection and interpretation of archaeological material, enabling a deeper understanding of how the Ravne Tunnels network had been utilized by different cultures through time.

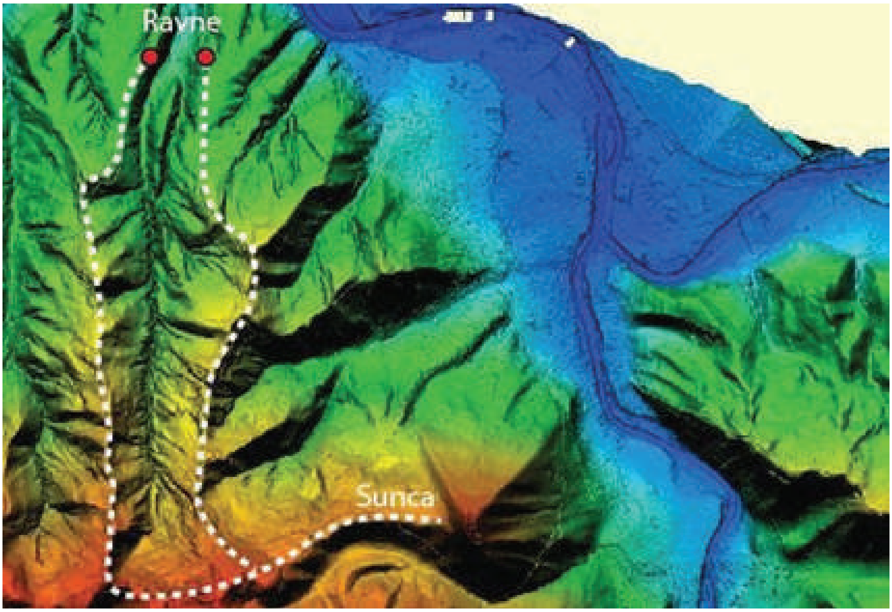


Figure 8; LiDAR imagery with two superimposed hypothetical routes from the Ravne entrances in the north-west (Ravne, right, Ravne3, left) towards the Bosnian Pyramid of the Sun in the southeast.


Photo 4; Ravne Tunnels being excavated in 2010. Loose rubble material being removed. A drywall construction retains material blocking side tunnel (right).

Photo 5; One of over 50 drywall constructions within the Ravne Tunnels. Drywalls mark position of infilled side-tunnels.

Photo 6; ‘Mega-ceramic block K2’ was found within the Ravne Tunnels. Object is out of context from material found within the Ravne conglomerate in terms of shape, size and composition.

Photo 7; Ravne Tunnels being excavated in 2010. Loose rubble material is being removed from the blocked passage.

**Ravne3 C2 Excavation**

During initial exploration of the Ravne3 site in June of 2018 several small exposures of the Ravne conglomerate rock were identified (photo 8). The largest of these exposures appeared to have been undercut, leaving a small cavity space between the 'floor' and the base of the conglomerate. These cavities were given the labels C1 to C5, with C1 being the most southerly outcrop and C5 being the most northerly. Ground clearance was conducted, removing trash, trees, bushes and undergrowth both up and downslope in the area surrounding the cavities. Earth moving equipment was brought to the location to create a flat terrace in front of the cavities for ease of access and workspace. (photo 10). Topsoil was removed and the marl was excavated down to approximately one metres depth.

C2 was selected for excavation as it was the largest of the five cavities. Upon close inspection a cold stream of air could be felt exiting the cavity, indicating that there must be a larger unseen space deeper underground allowing for circulation of air.

Photo 8; Cavity opening Ravne3 'C2' before excavations. Gap between floor and base of conglomerate is approximately 15-20 cm. Cold streams of air exiting the small cavity hinted at a larger cavity space allowing air circulation.

Photo 9; The original Ravne Tunnels entrance in 2006 prior to being excavated.

Photo (8) and (9) show the similarities between how cavity 'C2' at the Ravne3 site and the original Ravne entrance site both looked when initially observed, prior to excavation. The cavity opening of the original Ravne Tunnels entrance was found larger than the 'C2' cavity opening, likely due to its proximity with a nearby road, where it had been utilized for various purposes by the local populations right through until 2006. It was only when Dr Osmanagić initiated excavations at the original Ravne Tunnels entrance, emptying the partially in-filled cave of rubble, was it realised there were passages towards the rear of the accessible space.


Photo 10; Earthworks being conducted in front of cavity 'C2', removing covering soil and marl layers beneath conglomerate exposure.

Photo 11; Ravne3 'C2' shortly after initial excavations began. Approximately two metres worth of loose unconsolidated 'filling' material has been removed, revealing a vague but present route into the cavity space.

Photo 12; Pick-axe marks location of the vague rubble filled passage between solid conglomerate (ceiling), marl (floor) and unconsolidated filling material (walls)


Photo 13; Image shows flattened access path in front of excavation site 'C2'. Looking north.

## Methodology

Excavations at site Ravne3 followed a similar procedure to that of the original Ravne tunnels. An unconsolidated rubble composed of disaggregated Ravne conglomerate had been placed inside the cavities cut into the Ravne rock unit (figure 8, photo 12, 16). This rubble, despite undergoing compaction due to gravity, settling out over time, is loose and falls away from the solid conglomerate cavity walls quite easily when disturbed (photo 14, 15). Though having a similar composition, due to its unconsolidated disordered nature, the filling material also appears slightly different in colour to that of the surrounding bedded conglomerate (brown & grey respectively). Unique to the Ravne3 site, at some point in the past the cavity fill has been excavated, creating a small passageway through the rubble, allowing access into the Ravne3 tunnels (figure 8). This passage cutting through the cavity fill has then later been blocked back up in the same fashion using the same type of loose rubble material as that originally filling the cavity. Due to its younger age than the surrounding cavity fill, this later passage fill material is less compacted and contains little to no plant roots. To gain access into the Ravne3 tunnel network excavations in 2018 concentrated on the removal of the younger passage fill material only, leaving most of the older cavity fill material still in place. Hand-tools i.e. picks and shovels, were used to pull the loose material out from the blocked passage.

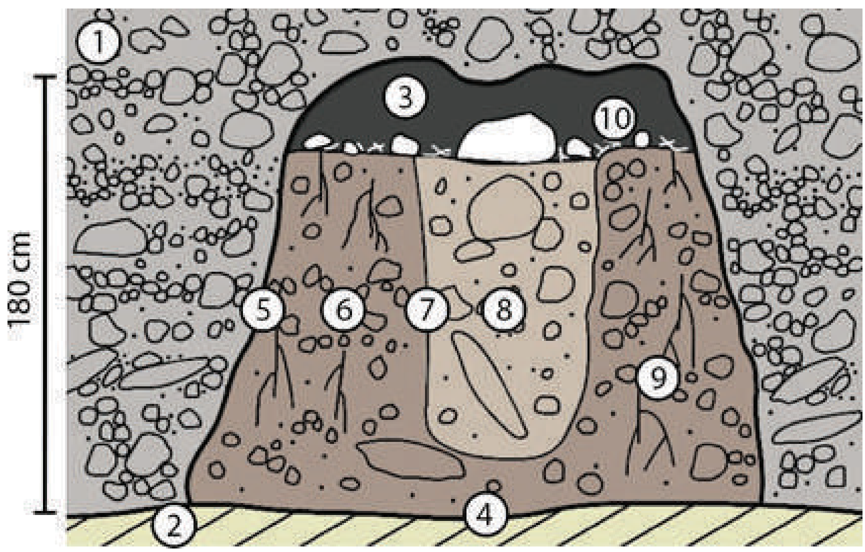



Figure 8; Simplified diagrammatic view of the stratigraphy at Ravne3, C2. 1)Bedded conglomerate. 2)Bedded marl. 3) Cavity space. 4) Cavity floor/ geological boundary. 5) Cavity walls. 6) Unconsolidated cavity fill. 7) Vague passage through cavity fill. 8) Unconsolidated passage fill. 9)Roots. 10) Cave fall/litter. Cavity height; 1.8 m

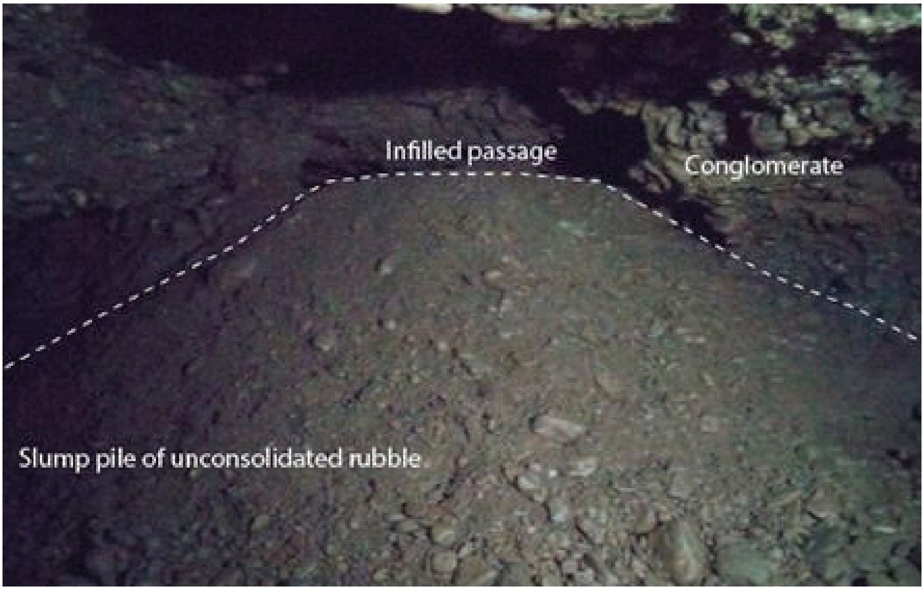



Photo 14; Ravne3 Tunnels, chamber R3-2. Unexplored passage is blocked with loose unconsolidated rubble. Material is slumping out from passageway.

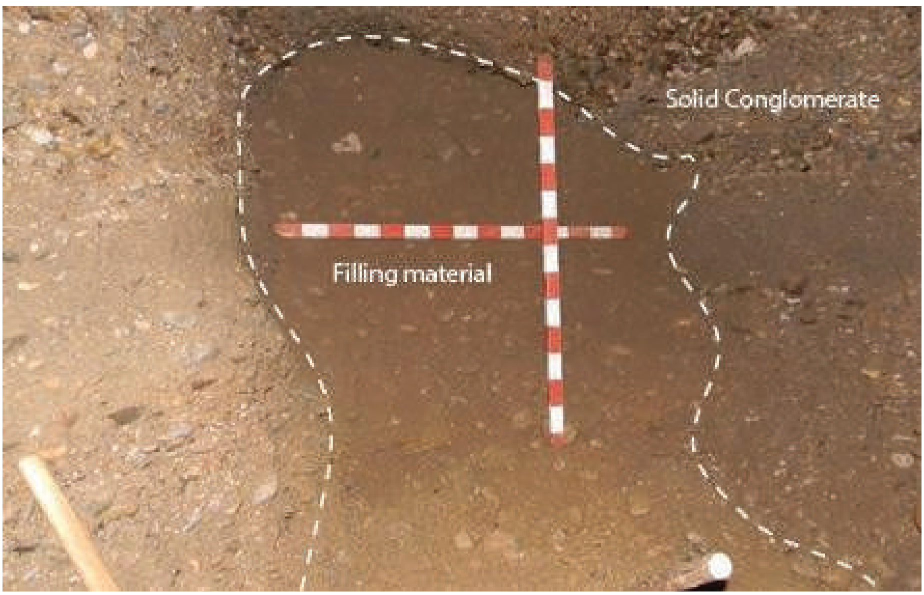



Photo 15; Ravne Tunnels. Unconsolidated rubble fills the passage cut into the conglomerate. Loose rubble easily falls away from the solid tunnel walls when disturbed. Note slight variance in colour between the two material types.

Photo 16; Image shows disaggregated Ravne conglomerate (Clasts with coarse calcareous sand matrix). This material was used to block the passages within the Ravne Tunnels complex.

**Ravne3 C2 Blocking Stone**

Shortly after excavation of cavity passage 'C2' began, a large cubic limestone boulder was identified partially buried within the loose rubble material filling the passage (photo 17 & figure 9). This object was referred to as the 'Blocking Stone' as it was positioned in the middle of the excavated passage hampering progression, at approximately three metres depth from the cavity entrance. The boulder, composed of a hard blue limestone, was placed in the centre of the infilled passage and was found resting on two smaller sandstone slabs with regular flat sides forming a stable horizontal plinth for the boulder to rest upon. The boulder and stone plinth were buried amongst the passage filling material with approximately ten centimetres of the boulder exposed above the surface of the fill, leaving a small gap of four centimetres between the top of the boulder and the conglomerate ceiling. The purpose of the 'Blocking Stone' as the name suggests was likely to hinder easy access into the cavity space beyond it, although its presence did not completely block up the space between the cavity ceiling and top of filling material (photo 18). Compaction over time due to gravity may account for the inadequate infill volume, if sealing the cavity completely was the intent. The secondary purpose of the 'Blocking Stone' may have also been as a retainer, to prevent displacement of the filling material from the cavity.

Photo 17; Dimensions of 'Blocking Stone'; h.70 cm x w.70cm x d.60, approximately cubic in shape, resting on asymmetric sandstone plinth composed of two sandstone slabs. Scale; 30 cm.

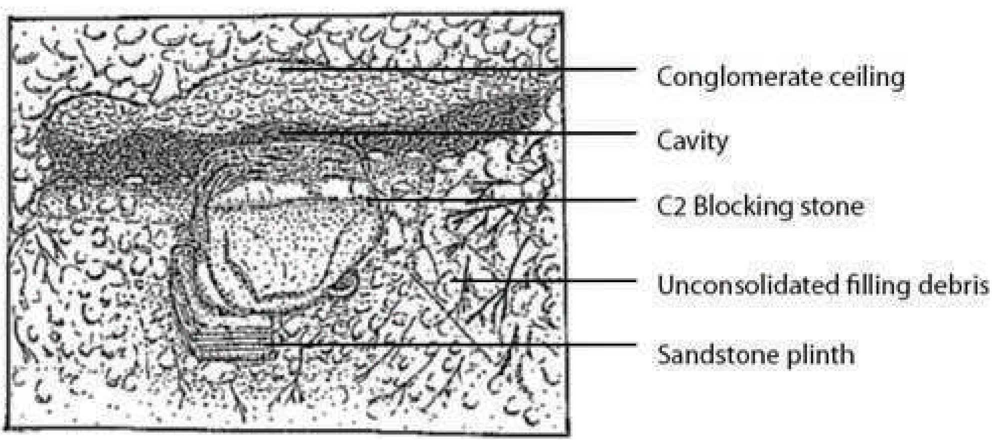



Figure 9; Field sketch of C2 blocking stone and plinth stones during passage excavation, July 2018.

Photo 18; Larger cavity spaces seen beyond the 'C2 Blocking Stone'. Floor of cavity is covered with cave fall and animal litter. Height of ceiling is approximately 40-50 cm.

**Ravne3 C3 Excavation**

In order to continue excavations at cavity 'C2' and enter the larger cavity space beyond it, it would have required removing the 'C2 Blocking Stone' boulder and thus destroying the first piece of anthropogenic evidence identified at the Ravne3 site. Fifteen metres north of 'C2' was another exposure of conglomerate with a small opening between it and the floor (C3, photo 13, 19). Again, cold air circulation was detected at this location. Because of the proximity to 'C2' and the trending direction of the cavity approximately heading towards the same point in space as the 'C2' passage, it was hypothesised that it would be possible to enter the large deeper cavity space behind the 'C2 Blocking Stone' from the 'C3' entry point, preserving the obstructing 'C2' boulder by circumnavigating it (photo 13, 20).

As was the case with 'C2', after removal of topsoil it was possible to identify a clear lithological difference between the consolidated Ravne conglomerate, the unconsolidated cavity filling material and the disturbed rubble which infilled a vague passage through the filling material. Excavation at 'C3' was carried out using the same method as at 'C2', removing the loose rubble material from the infilled passage, allowing deeper access into the cavities within the Ravne conglomerate (photo 20).

Photo 19; Cavity 'C3' is 15 m north of cavity 'C2'. Image shows cavity 'C3' shortly after removal of rubble from infilled passageway began.

Photo 20; Cavity 'C3'. Looking beyond the excavation face. Removal of disaggregated rubble allowed deeper access into the small cavity at 'C3'. An open chamber, free of filling material is seen beyond the cavities back wall.

**Ravne3 C3 Blocking Stone**

At six metres horizontal tunnel depth another 'blocking stone' was identified (photo 21). Contextually in both shape and position, this object stood out from the rest of the clasts within the rubble. The dimensions of the 'blocking stone' were much smaller than the 'C2' blocking stone but its composition was the same hard blue limestone as the 'C2' boulder. Its shape was slab-like with an irregular top face. The slab was buried within the upper portion of fill material, one metre above the passage floor. As was the case with 'C2' blocking stone, this slab was only partially buried, having the bulbous upper part of the boulder protruding out from the surface of the fill. Placement of the stone coincided with the point at which the cavity space began to enlarge, signifying its purpose was likely to restrict access to the cavity beyond it. Because of its reduced size, logistically it was much easier to displace and so it was decided to remove this blocking stone from the passage and continue excavating deeper into the Ravne3 tunnel network (photo 22).

Photo 21; Partially excavated cavity 'C3' blocking stone purposefully placed within the upper portion of the fill material at the point where the cavity space began to enlarge. Scale; 30 cm.

Photo 22; Limestone cavity 'C3' blocking stone aka 'Lucies Stone'. Dimensions; h.30 cm x w.30 cm x d. 70 cm. Due to moisture within the filling material the darkened portion of the rock demonstrates how the lighter coloured top portion of the slab protruded out from the filling material into the cavity.

**Unblocked Ravne3 sections**

During August 2018, approximately one month after excavations began at the Ravne3 locality, digging through the unconsolidated infill rubble at cavity 'C3' had reached a horizontal tunnel depth of 8 metres (photo 23). At this point the cavity branched off into three directions, approximately north- west, south-west and south (figure 10). The northwest and southern passages were found as the entry passage, blocked up near to the cavity ceiling with unconsolidated rubble. The south-west passage however was not, but was empty of any infilling material enabling free movement within the space (photo 24).

Photo 23; Cavity 'C3' after excavating to 8m tunnel depth. Passage seen cutting down into underlying marl beds. Tunnel height is approximately 1.7 m and 1.5 m wide

Photo 24; At 8m tunnel depth a section of passages with chambers free from rubble infill was found, allowing free movement within the cavity.

The unblocked part of Ravne3 was found to be composed of three distinct sections; Two chambers and a narrow, straight passage connecting them. The first chamber (R3-1) found at the beginning of the unblocked section is the smaller of the two chambers, measuring approximately l.6m x w.3m with a height of 1.5m (photo 25). The second chamber (R3-2), though longer and wider than the first (l.24m x w.3 to 5m) only had a ceiling height of approximately

80cm, making it difficult to move through the cramped space (photo 27). Two side-tunnels heading north and south at the end of the large cavity form a T junction and were found blocked by disaggregated rubble. Consolidated blocks of Ravne conglomerate that appeared to have collapsed from the cavity ceiling also hindered further access into these passages.
A major dissimilarity between the two chambers was the condition of their floors. Both chambers and the connecting passage had floors raised from the underlying marl with the use of disaggregated conglomerate rubble. In the first chamber the thickness of this floor ranged between 30-50cm. Though in both chambers the surface of the raised floors were littered with pebbles and cobbles, likely cave fall, the second larger chamber floor was much more uneven and had a greater amount of lithic debris on its surface. The first, smaller chamber looked as though it had been cleared and given a more even surface.
Temperature within the explored sections of the Ravne3 Tunnels is a stable 10°C-12°C throughout the year. The air inside has a relative humidity is 66%. This level of humidity is above optimum levels for human comfort (approx. 50% upper limit) but below the optimum level for mould growth (70%). Oxygen concentration is optimum and stable at 20.9% and is comparable to the air outside, making it perfectly safe to breath inside Ravne3 without the aid of respirators or artificial ventilation. Oxygen negative ion concentration inside the tunnels at 32m tunnel depth was measured at 5500 parts per cubic centimetre, compared to the air outside the tunnels which only has a -ve ion concentration of 450ppcc. All of these measurements match or are very similar to the conditions found within the original Ravne Tunnels.

## Subterranean map of Ravne3 Tunnels

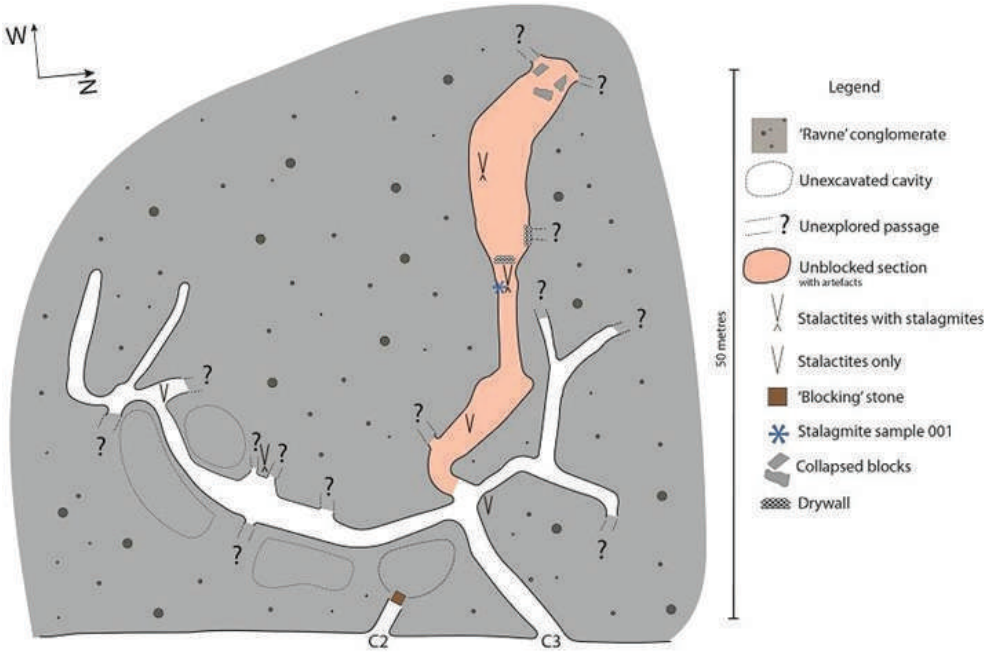



Figure 10; Map shows explored sections of the Ravne3 Tunnels network with blocked unexplored passages and approximate heading indicated.

Map current as of October, 2019.

## Ravne3 Tunnels/chambers

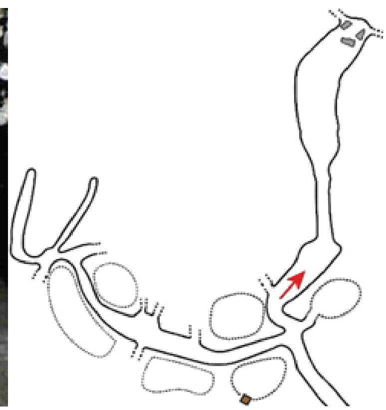


Photo 25; Chamber R3-1, the first chamber within the Ravne3 tunnel network to be identified without any blocking filling material. Dimensions approximately l.6m x w.3m x h.1.5m .Looking north-west.

Photo 26; Passage R3-W1, a straight passage lacking filling material, interconnecting two chambers (R3-1 & R3-2). Brightly illuminated section identifies where stalagmite S-001 was extracted. Looking west.

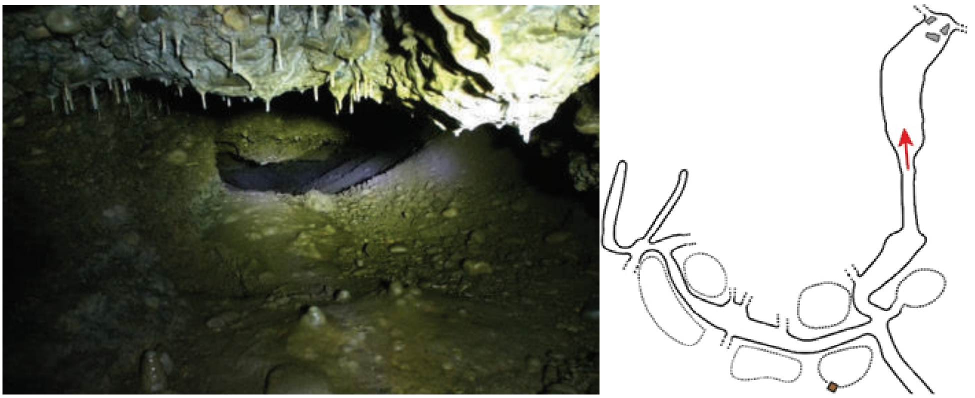


Photo 27; Chamber R3-2, the largest chamber to be so far identified within the unblocked sections of the Ravne3 tunnel network. Chamber curves towards the north-west. Looking west.

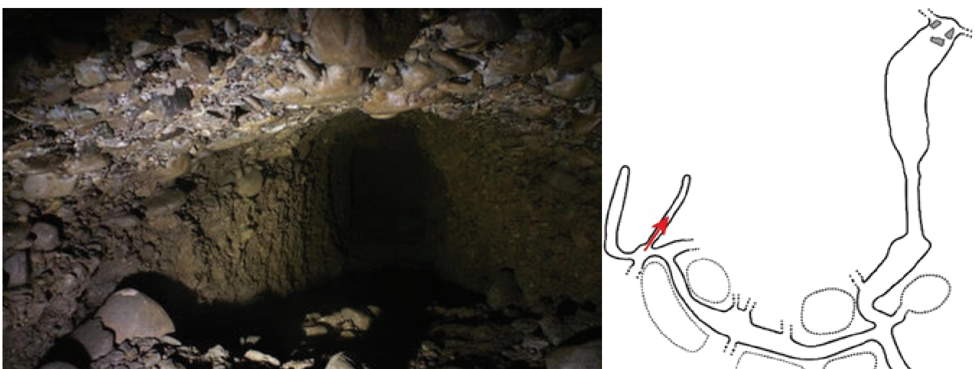


Photo 28; Passage R3-W2 curves before ending abruptly. Passage was found lacking any filling material.

Photo 29; Dr Sam Osmanagić with volunteer coordinator Marie-Sophie Gristi are the first to reach the farthest extent of the open section within the Ravne3 Tunnels, approx. 60m from the entrance.

**Ravne3 Speleothems**

Within the explored sections of the Ravne3 Tunnels are six locations where stalactites and stalagmites have formed (figure 10). Three of these locations have both stalactites and stalagmites, whereas the remainder only have stalactites. The speleothems are a product of slightly acidic groundwater percolating through the porous Ravne conglomerate, dissolving calcium carbonate contained within that rock unit and then redepositing it as a precipitate when the water comes into contact with oxygen held within the cavity space. Stalactites are of the thin and delicate 'soda-straw' variety, and rarely exceed ten centimetres in length (photo 30, 31). Some of these 'soda-straw' stalactites were found to have been broken prior to the 2018 entry into the Ravne3 Tunnels. Several of the broken stalactites had reformed, showing two phases of growth and indicating the breakage did not occur recently (photo 32). Stalagmites that had formed on the undisturbed floors of cavities are of both the button and cone shaped variety, also growing no larger than 10-12cm in height (photo 33). The highest concentration of stalagmites was found at the end of the straight passage connecting to chamber R3- 2, with three cones and at least six button shaped stalagmites clustered together. With considerable stalactite growth above the swarm of stalagmites, the speleothems at this location formed a natural barrier between the two different tunnel sections (photo 27).

Photo 30; ‘Soda-straw’ stalactites at end of passage connecting chambers R3-1 & R3-2

Photo 31; Flowstone with soda straw stalactites within chamber R3-1

Photo 32; Broken stalactite within chamber R3-2 shows a second phase of regrowth. Total length 7cm

Photo 33; Cone shaped stalagmites found at western end of passage leading to chamber R3-2

## Geochronology

Using radiometric dating methods it is possible to ascertain an age for the formation of the stalagmites present within the Ravne3 Tunnels. Two cone shaped stalagmites (S001 & S002) were selected for analysis (photo 34). Stalagmite S001 was dated using 14C radiocarbon content analysis and stalagmite S002 was dated using the U-Th ICP-MS protocol (lab reports for each analysis containing further details of the results can be found within the appendix of this report).

Using 14C radiocarbon dating the age of stalagmite S001 at 1cm above its base was given to be 26.2 ± 0.25 Ka (Due to extraction method the stalagmites absolute base remained in situ and was not dated therefore the given age is likely lower than had the absolute base been analysed).
Using U-Th ICP-MS the age of stalagmite S002 at its base was given to be 5.9 ± 0.3 Ka

Photo 34; Cone and button shaped stalagmites. Samples used for radiometric dating indicated (S001,2)

The discrepancy between the two ages given is significant. Both stalagmites were found near to each other at the same stratigraphic level and were approximately the same size in both height and width, which suggests they should be of the same approximate age. The differences in the given ages is therefore likely due to the chosen methods in which they were dated.
The results gained from radiocarbon dating of stalagmite S001 is problematic due to the speleothems content of 'dead carbon'. For a radiocarbon date to be accurate in this case ideally all of the carbon within the stalagmite, including

radiogenic 14C, would be derived from the atmosphere contemporary with the precipitation of the calcium carbonate. In reality, much of the carbon is derived from the dissolved carbonate ions from within the Ravne conglomerate. Because of the age of the rock being on the geological timescale and because 14C has a relatively short half-life of 5,730 years, the Ravne conglomerate will contain no measurable radioactive carbon. The dissolution of carbonate ions from the Ravne conglomerate will result in a reduction of the 14C/12C ratio and therefore radiocarbon dating of the stalagmite will produce an age much older than when the stalagmite actually formed. Uranium-thorium dating does not suffer from contamination in the same way. The groundwater moving through the Ravne conglomerate will dissolve both carbonate and trace amounts of uranium, but at near-surface conditions thorium is not soluble and therefore any thorium within the Ravne rock will not affect the results as it is unable to find itself within the calcium carbonate precipitate (stalagmite). U-Th dating is known for its accuracy and reliability of dating calcium carbonate precipitates and therefore there is high confidence in the above result. 14C radiocarbon dating however, is best suited for use on organic material derived from a living organism and therefore the above yielded radiocarbon age should be disregarded.

**Age of the Ravne3 Tunnels**

The age derived from stalagmite S002 has not produced an absolubte age of the Ravne3 Tunnels due to several factors; Firstly it may take several thousand years of calcium carbonate to precipite, first forming a shelfstone on the cavity floor before vertical growth of the stalagmite begins. Stalagmite S002 was attached to a shelfstone approximatly 3-4cm thick that cannot be dated using U-Th with any accuracy due to high concentrations of clay, lithics and other detritus found within the cavity floor. Secondly, anthropogenic activity within the tunnels would certainly hamper the formation of a stalagmite. If the floor of the passages were being walked on, a footstep would interfere with the precipitation of the carbonate. Oils on the skin or on footware upon contact with carbonate-bearing water can disrupt its surface tension, inhibiting stalagmite growth. Taking these factors into account, the age of 5.9 ± 0.3 Ka that stalagmite S002 has yielded can be used only for the absolute minimum age of the Ravne3 Tunnels, with the expectation that it is older. Likely the radiometric derived age only tells us when human activity inside the tunnels, where stalagmite S002 was extracted from, ceased.


Photo 35; Stalagmite S002 was cut in half to prepare a small carbonate sample from its base for U-Th dating.

**Archaeological Material**

From early 2019 excavation methodology changed as did the focus of the investigation at Ravne3. Excavation and exploration of the infilled passages continued but archaeological work would also begin within the sections of the tunnels that were found unblocked. Overseen by field archaeologist Amna Agić, archaeological trenches measuring 1m square were dug systematically across the raised floors of chambers R3-1 and the connecting passage leading to R3-2. Trenches were dug down to the original floor of the cavities, marked by the underlying marl beds, eventually removing all of the rubble forming the raised floor (approx. 30-50cm thickness). At time of writing of this report work has also begun in the larger chamber R3-2, with several trenches having now been excavated.

Photo 36; 1mx1m trench excavation of the Ravne3 floor. It is this raised floor where the majority of finds were made.

**Evidence of tool markings**

Within the southwest conglomerate wall of chamber R3-1 was identified a wavy lentiform deposit of soft yellow clay, 10-15 cm in thickness and 1 m in length, which is a large entrained rip-up mud-clast (photo 40). The cohesive and malleable properties of the clay provide evidence of tool-use within the cavity which otherwise would not have been preserved by the conglomerate.

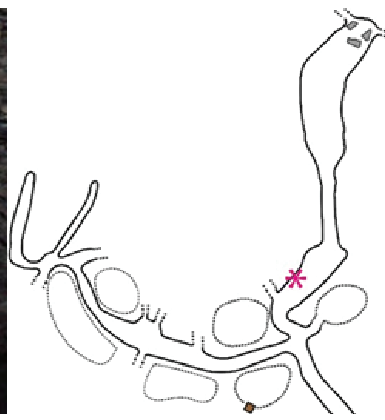



Photo 40; Lentiform mud-clast seen within
the south-west conglomerate wall of chamber R3-1.
Scale 10x7 cm.

Tool mark (1) is Elliptic cylindrical in shape, the hole is 5 cm in depth and tapers towards a flat distal termination (photo 41, 42). Entry hole is 3x2 cm. Deformation of clay surrounding the entry hole gives the impression the tool was being used at time of impact with a downward swing. The tool being used that created this impression could possibly be a blunt pick-like implement. Tool marks (2) and (3) are similar, convex (concave-upward), tapered and coming to a blunted point at their distal termination (photo 43). Outer edges are radiused and the holes are <2 cm deep. These markings could possibly be formed by a flattened chisel-like implement.

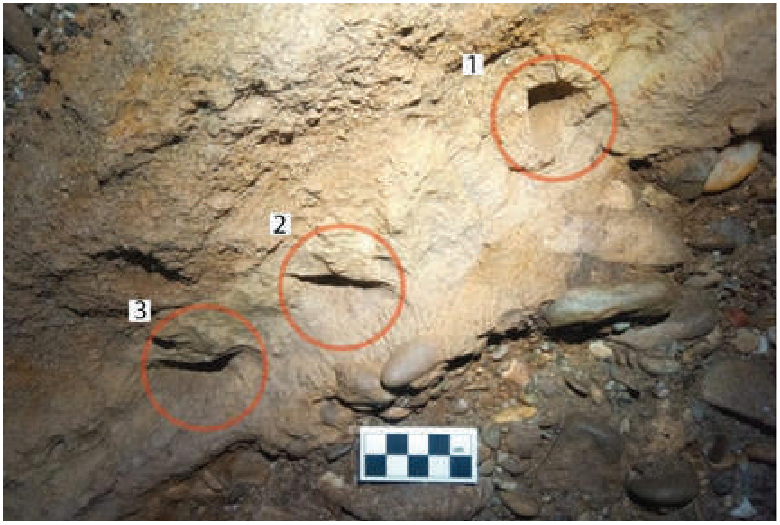



Photo 41; Three preserved tool impacts within the soft clay.

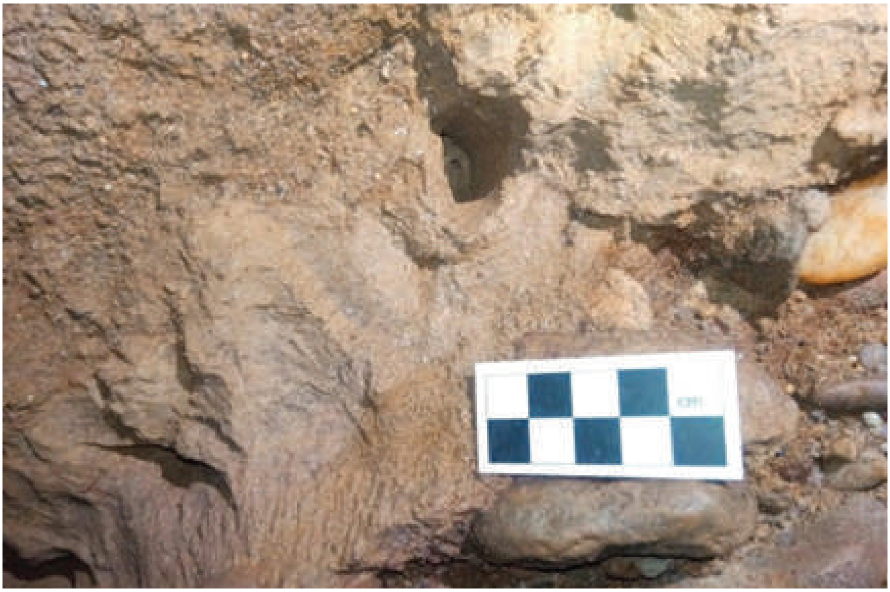


Photo 42; Tool mark (1). The hole is 5 cm. Entry hole is 3x2 cm.
Clay compressional deformation is seen below the hole.

Photo 43; Tool mark (3) seen here was created by a flat edge.

A second entrained mud clast was identified within the conglomerate ceiling at an opening of a small passageway towards the south end of the explored Ravne3 Tunnels (photo 44). Striations appear to have been produced by the downward swing of an object similar to that of tool mark (1).

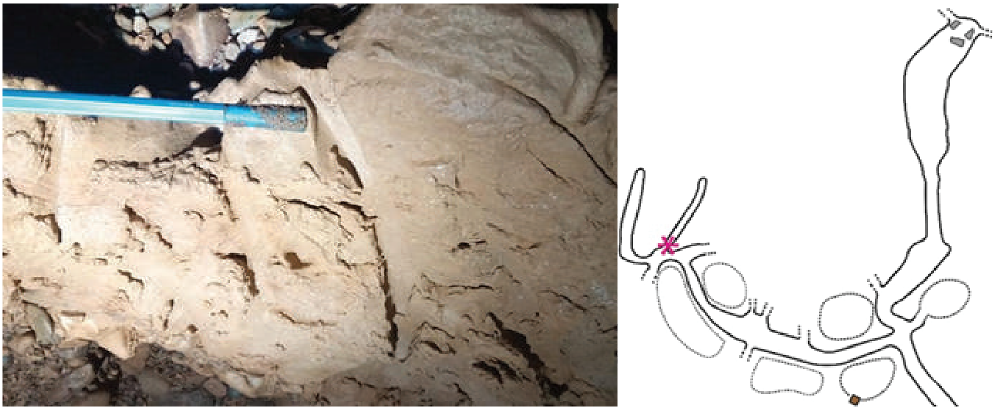


Photo 44; Tool mark (4) produced by downward swing of a pick

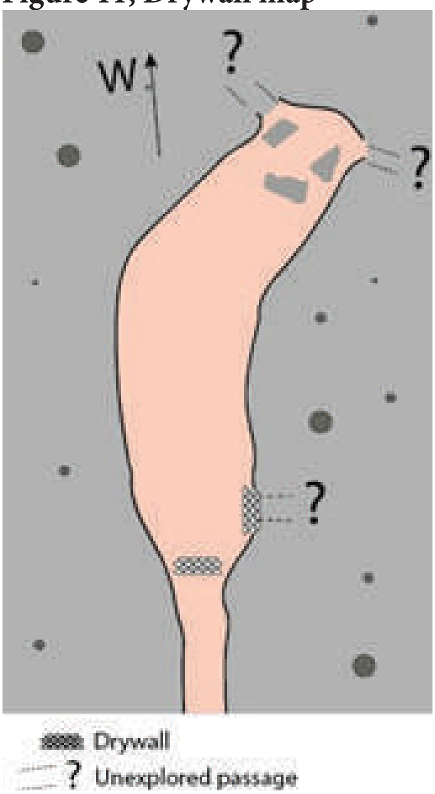
It is conceivable that all of the above identified tool markings were created by one single type of tool, for example a pick that has both a pointed tip and a flat faced blade (photo 45). Whether or not these tool markings are original from the time of creation of the Ravne3 Tunnels, or if they came later and more recent occupants of the tunnel modified already existing passages for their own purposes, has yet to be determined.

Photo 45; Example of a Bronze-age adze-axe from Balkans region of similar shape and specifications may have been able to produce the tool-marks.

**Drywalls**

The first drywall to be found in the Ravne3 Tunnels was discovered in early October 2019. A drywall is a simple structure built only from carefully stacked stones, held together by gravity and friction and without the use of any binding material (cement, mortar etc). The Ravne3 drywalls are composed of rounded riverbed stones, often with their flat facets facing outwards. The first wall is small with only 5 courses of stone high, approximately 60cm tall, and only one course thick (photo 37). The wall is straight, without any curvature from one end to the other and was found positioned across an intersection within the tunnels between a narrow straight passage and a larger, wider chamber (figure 11). The drywall was discovered buried beneath a heavily calcified block upon which stalagmites had formed. The form of the drywall discovered in the Ravne3 tunnels matches those previously discovered in the original Ravne Tunnels, both in form and material (photo 38). This is the first piece of archaeological evidence identified within Ravne3 that links anthropogenic activity with that of the original Ravne Tunnels.

**Figure 11; Drywall map**



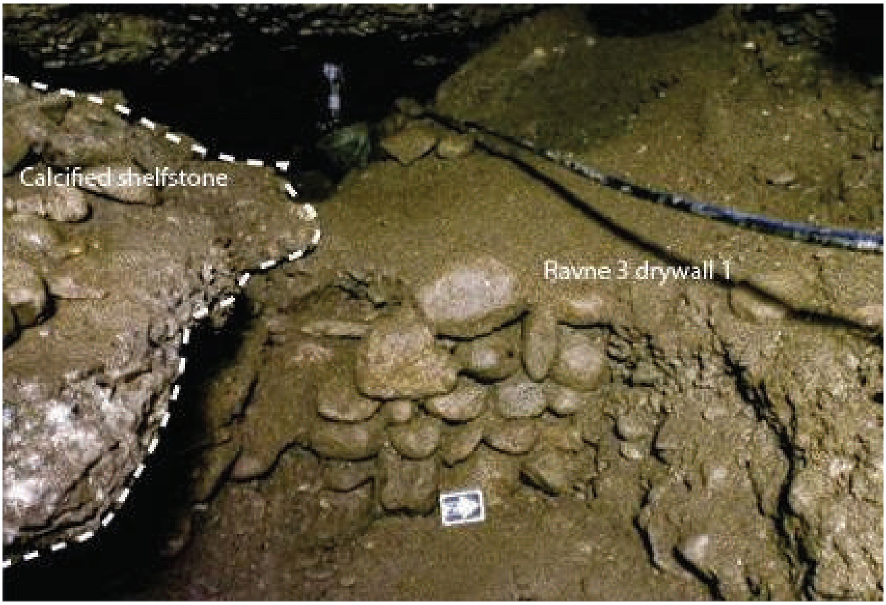



Photo 37; Ravne3 Drywall 1 (R3-dw1), the first drywall discovered at Ravne3

Photo 38; A comparative drywall located in the Ravne Tunnels
on the opposing side of the valley

Shortly after the discovery of the first Ravne3 drywall, a second, larger drywall was discovered and excavated in mid-October, 2019 (photo 39). This drywall is much more substancial than the first, composed of 9 to 12 courses of rounded riverbed stones, 80cm tall and at least 110cm wide. Located approximately 1m behind the first drywall and positioned perpendicular to it, along the northern side of the large chamber. It marks the position of an infilled side-tunnel that heads in a northerly direction from the east-west trending chamber R3-2 (figure 11).

The recurrence of a second drywall within Ravne3 suggests there is an extensive network of tunnels still left undiscovered at Ravne3. As is the case within the original Ravne Tunnels on the opposing side of the valley, when a side tunnel marked by a drywall is excavated it often leads to more tunnel junctions and side passages with further drywalls. The drywalls in the Ravne Tunnels complex appear to serve two main functions. The first purpose is to mark the location of side-tunnels along the main passageway throughfares. The walls are almost always found parallel to the main passageways, along its sides, with the hidden side-tunnels perpendicular to the main passageways. The second function is to act as a retaining wall. The majority of passageways at Ravne & Ravne3 Tunnels have been blocked up with loose unconsolidated rubble. The drywalls hold this loose material in place, preventing slumping, and allowing the passageways to be filled up to the ceiling completely.

Photo 39; Ravne3 Drywall 2 (R3-dw2), the second and largest of the two drywalls discovered at Ravne3

**Dating of the drywalls**

Stratigraphically, drywall R3-dw1 was found below a cluster of small cone and button shaped stalagmites and is therefore older than those speleothems. The closest of these stalagmites to the drywall has been given the designation 'S008', located approximately 1.5m west of the previously dated stalagmites S001 (C14) and S002 (U-Th). Future radiometric dating of stalagmite S008 will provide a minimum age for the construction of the drywalls in Ravne3.

**Lithic artefacts**

A single dark green pebble that appears to have been modified by man was identified beside the first drywall discovered in Ravne3 (R3dw-1). The hard pebble is crystalline and porphyritic, setting it apart from the usual softer sedimentary carbonate pebbles found within the Ravne conglomerate. The reshaped pebble has been abraded to a smooth point at one end and given two identical divots that have been chipped into both sides at the pebble's midpoint. The single line of symmetry of the modifications indicates that conscious effort was made to manually reshape this stone, rather than it being damage randomly afflicted upon the pebble.

Photo 46; Pebble can be seen coming to a smooth point at one end and has near identical equatorial divots either side. Size; l.11cm w.6.5cm

Photo 47; Showing one of the divots chipped into the side of the pebble.
Both divots are dimensionally similar.

**Pottery/Ceramics**

A total of 3132 fragments of pottery were excavated from the raised floor of the unblocked sections of Ravne3 (photos 48 to 53). The floor of the chambers and passages within the unblocked section were raised above the marl surface by approximately 30 to 50 cm, using loose rubble, similar to that used to block up the infilled passages. The finds were mostly concentrated within the floor of the first chamber R3-1, with density of fragments decreasing along the straight passage towards the stalagmites (S001, S002) and large rear chamber R3-2. The rarest type of pottery identified within the Ravne3 Tunnels represented the Bosnian Roman period. Finds included a single Roman tegula tile, ornamented with a Celtic knot motif (Photo 48) and an incomplete luxury Terra sigillata pot (photo 49). Besides these few pieces, the majority of pottery fragments represented the Bosnian medieval period, belonging to low quality pots likely intended for domestic use. These pots were thin walled and had simple, if any, ornamentation (photos 50 to 53).

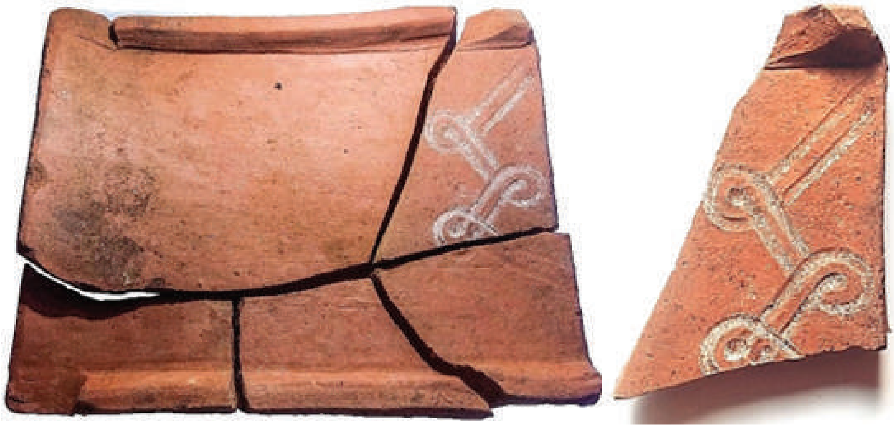


Photo 48; Roman Tegula tile with Celtic knot motif (insert). Containing carbonaceous sand, there is potential the tile was manufactured with materials local to Visoko.
Size l.41cm h.26cm

Photo 49; Partially reconstructed Roman Terra Sigillata luxury pot.
Diameter; 11cm

Photo 50; Partially reconstructed medieval domestic pot
rim w.13cm h.21cm

Photo 51; Example fragments of medieval pottery found in Ravne3.
Seen here is a pot neck & rim (left) and the partial reconstructed base of another

Photo 52; Example fragments of pottery with simple line ornamentation found in Ravne3.

l.4-5cm

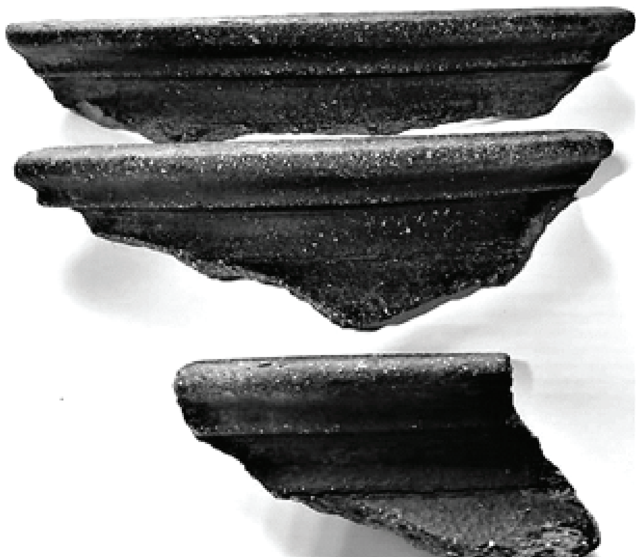


Photo 53; Fragments of medieval pot rim. Simple line ornamentation and visible coarse sand grains indicates this is a low-quality domestic piece. l.6.5-16cm

## Metallic Artefacts

A small number of metallic artefacts were recovered from the open section of the Ravne3 tunnels. Due to the high moisture content within the raised floor the majority of ferrous finds were beyond identification, however, some of the larger items with distinct and simple shapes were able to be recognised and include nails and a cutting blade (photo 54). Some of the bronze artefacts fared much better to the oxidizing conditions of the Ravne3 Tunnels while others did not (photo 55, 56).

Photo 54; Ferrous metallic objects heavily corroded, including cutting blade, (l.28.5cm) and hand-made nails (l.11-12cm).

Photo 55; Bronze pendent with abstract Celtic motif, possibly Roman period. Diameter 1.5cm

Photo 56; Heavily corroded bronze coins
Diameter; 1-1.5cm

Typographic analysis of the included artefacts within this report were carried out by Foundations field archaeologist Amna Agić. For further details see 'Archaeological Report of Ravne3 Excavations, Visoko, Agić, A., 2019.

**Conclusions;**
**Summary of finds;**

Tool markings may have been original features belonging to the time when the tunnels were first created or they may have come later, when occupants utilizing the Ravne3 Tunnels emptied the now open sections of filling material. These open sections may have been modified, enlarging the cavities for practical use and so perhaps the tool markings were created at this time. One observation to support the latter conclusion is that to date there is no record of tool markings being identified when an infilled passage has been emptied in modern times of its filling material.

Drywalls are the oldest archaeological structures found within the Ravne3 Tunnels, being excavated from underneath loose debris slumping out over them from the infilled passages behind them. Stratigraphically they were also found under the strata that has stalagmites on top (yet to be dated). The drywalls and the loose debris infilling the passages are contemporary with each other. Purpose of the drywalls is principally as a retaining wall, holding the loose infill rubble material in place behind it.

Lithic artefact shows primitive tool craftsmanship and usage within the open section of the Ravne Tunnels. It was found and removed by a volunteer who did not record the exact stratigraphic level at which the object was removed from, however, it was found at the time the first drywall of Ravne3 was being excavated.

The large quantity of ceramic fragments, along with the few metallic finds found within the Ravne3 Tunnels indicate there have been several phases of occupation of the Ravne3 Tunnels open section through time.

Because of the levels of humidity within the tunnels being at the upper limit of human comfort, and because of the cramped spaces with the ceiling height making it difficult to stand-upright for anyone but the shortest of people, it suggests permanent habitation of the tunnels was unlikely. However, the low quality domestic medieval pots suggest at this time the tunnels may have been used for storage. With a stable temperature of 10°C-12°C throughout the year, the Ravne3 Tunnels may have served as an excellent place to store food that spoils quickly within the warm summer months. The tunnels therefore may have been utilized in this fashion for people living in settlements nearby, either on top of the hill above Ravne3 or within the valley below. The high concentration of negative ions within the atmosphere of the tunnels could also assist in prevention of food spoiling by inhibiting growth of bacteria.

**Order of archaeological events at Ravne3 Tunnels**

**1)** Creation of Ravne3 Tunnels is contemporary with the original Ravne Tunnels. Both the Ravne Tunnels and Ravne 3 Tunnels are part of the same extensive underground tunnel network, created by the same group for the same purpose. The existence of Ravne3 on the opposing side of the valley to the original Ravne Tunnels significantly increases the lateral extent of the complete tunnel network.

**2)** Ravne3 Tunnels infilled and drywalls built at same time as original Ravne Tunnels are blocked up.

**3)** Partial opening of tunnel sections at Ravne3. No later than 5.9 ± 0.3 Ka according to radiometric dating of stalagmite S002.

**4)** Utilization of Ravne3 tunnels – anthropogenic material brought inside (Roman tools, pots).

**5)** Surface entry to open section sealed up.

**6)** Open section reopened – More anthropogenic material brought inside (Medieval).

**7)** Surface entry to open section resealed until modern times.

**8)** Ravne3 discovered and excavated by the Bosnian Pyramid of the Sun Foundation.

**Future work; Ravne3**

The raised floor in the rear open chamber at Ravne3 (R3-2) still has its raised floor intact. Initial probing shows it is substantially thicker than in chamber R3-1 (up to approx. 1m thickness). This could point to there being great potential for further archaeological finds or instead, that the chamber was never fully emptied and utilized in the same way as R3-1 and therefore contains no finds. In either circumstance, removal and analysis of the raised floor will answer this question.

The identification of two drywalls in chamber R3-2 points to there being more passages still infilled at the Ravne3 site. Further radiometric dating of stalagmites at Ravne3 will be conducted with the hope of isolating a minimum age for the blocking of the tunnels and the construction of the drywalls found in R3-2. It is usual at the original Ravne Tunnels site that one side tunnel lead to several more so the potential to find more chambers and passages as yet undiscovered at Ravne3 is great. There are also the two passages at the end of the open section forming a T junction, with one passage heading south, which must be cleared and explored.

**Ravne 4**

In early November 2019 Foundation workers were creating level platforms for picnic tables at the park boundary on the lower slopes of the western side of the Ravne valley, approximatly 300m south of the Ravne3 entrance. While removing the top soils they uncovered sections of the Ravne conglomerate where it was observed a potential infilled passageway (photo 57). As more material was removed around the opening it became clear there was indeed a passageway leading to a large cavity space, partially emptied of debris, similar to how Ravne3 was originally found (photo 58). Exploration of the cavity led to approximatly 63m of open passages heading in a southwesterly direction (photo 59). Several drywalls were observed, some partially destroyed while another still in original condition, all marking yet more infilled passages behind them (photo 60). Work has now already begun at Ravne4 with securing of the site with the main body of excavation work beginning in 2020. Initially the first chamber will be emptied of its rubble and sifted for artefacts, similar to how work was conducted at Ravne3. There is a high probability that both Ravne 3 and 4 are connected by infilled passages and so work will also focus on excavating a route between the two locations as well as finding the most efficient route south, towards the Bosnian Pyramid of the Sun.

Photo 57; November 4, 2019. Ravne 4 entrance is being cleared shortly after its discovery.


Photo 58; The first chamber within Ravne 4 is found partially emptied.
Several infilled side tunnels are present (right)

Photo 59; A small emptied passageway in Ravne4 heading in a south- westerly direction. Water accumulates on the floor of the tunnel.

Photo 60; Drywall in Ravne4 discovered with loose rubble behind it

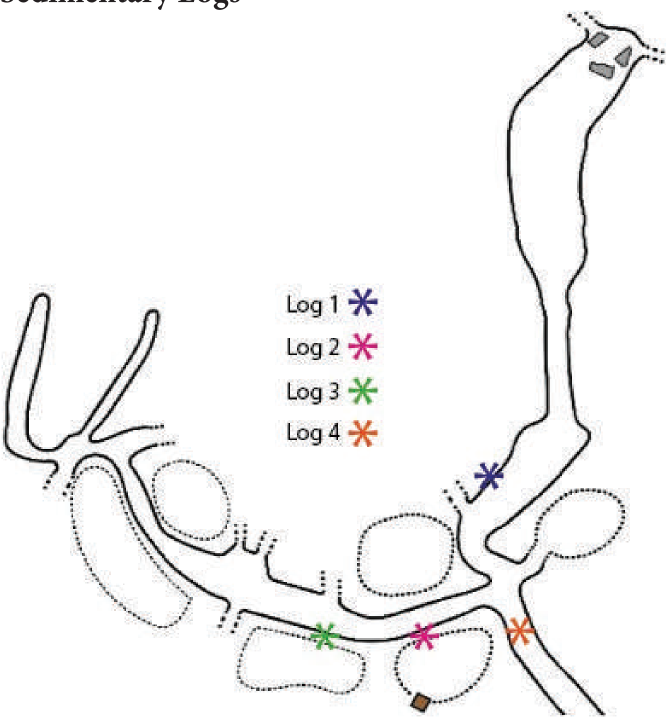
**Closing Words**

All work conducted at the Ravne3 site in 2018 & 2019 was done so with the selfless and generous help of volunteers coming from all around the world to Visoko, Bosnia. Without their sense of adventure, love, kindness, time and effort, the Bosnian Pyramid of the Sun Foundation project would not be where it is today. As the project enters its 15th year, the 2020 excavations will be the widest in scope they have ever been. This is the largest and most active archaeological site in the world and for it to continue, as it must, we ask you to consider becoming a part of this incredible discovery and joining the hundreds of volunteers who have already taken their hand to bucket, shovel, trowel & brush in the heart of the Bosnian Valley of the Pyramids.

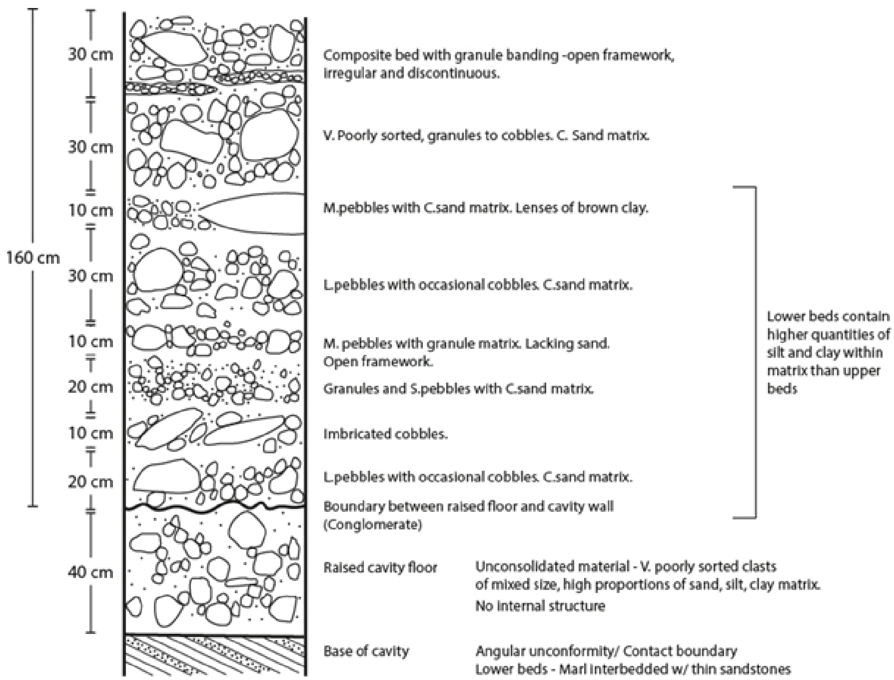
*– Richard Hoyle, Foundation Field Geologist.*

Dr Sam Osmanagić exiting the Ravne4 Tunnels shortly after its discovery in late 2019

## Appendix
## Sedimentary Logs



**Ravne3 Conglomerate Log 1**
Location; Southwest wall of chamber R3-1




Unit thickness; No greater than 10 m. Sheeted. Base is sharp, resting unconformable with Miocene marls below. Minor basal erosion.

Clast composition; Clasts shaped sub-rounded to rounded dominate with compositions sourced from outside of the depositional basin. Sedimentary clasts including limestones, dolostones and carbonaceous mudstones are most common. Clasts composed of metamorphic rock including schist and amphibolite follow. Vein quartz and igneous rock e.g. basalts are least common. Occurrences of carbonaceous & micaceous arenaceous sandstones are rare and generally found sub-angular to angular and are presumed to have been sourced from within the depositional basin or nearby. Size of clasts range from granules to boulders with an average clast size of 15 mm.

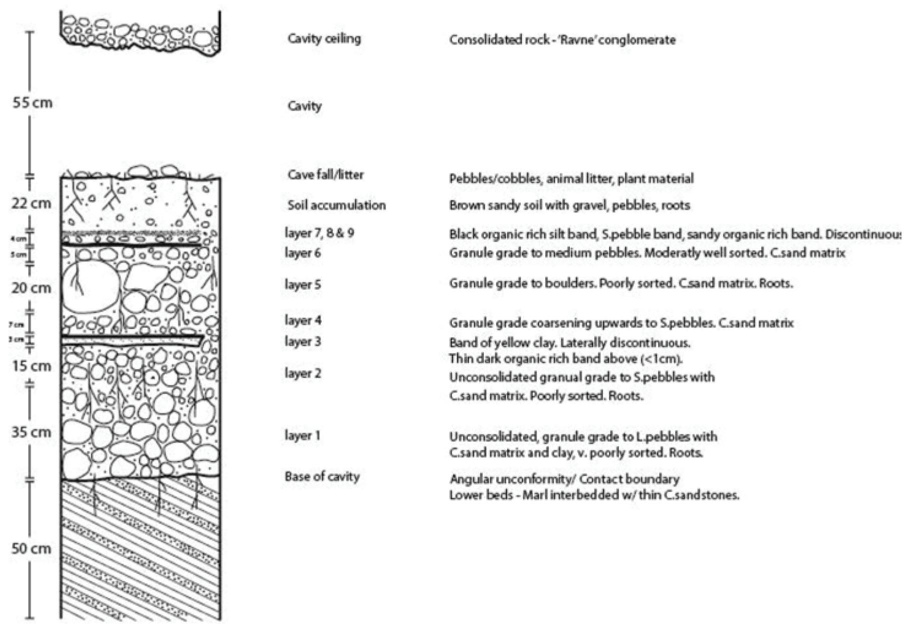
Matrix composition; Allogenic matrix is poorly sorted immature sand up to coarse grade with variable amounts of silt and clay sized particles. Precipitated authigenic matrix is calcium carbonate. Rock is poorly consolidated becoming more consolidated towards the exterior of the rock unit. Reacts well to HCl.
Fabric; Immature gravel and sand matrix. Poorly consolidated. Unit shows great

variability laterally and vertically. Clast supported throughout. Majoritively with a closed-framework showing crude and defuse layering, beds most often show no order within individual stratified layers. Sets of stratification show vague trends of coarsening upwards or complex grading. Layers of less coarse material can be seen to contain occasional outsized clasts. Less common are occurrences of thin (<1 dcm) well-defined open framework bands composed of granule to small pebble grade clasts. Irregular and discontinuous sub-horizontal lenses of clay occur throughout deposit. Thin layers of white calcareous sand are also common.

Classification;
Polymodal extraformational Closed framework oligomictic pebble orthoconglomerate.

Depositional environment; Upper reaches of alluvial fan deposit entering intermontane basin. Dense and highly viscous debris flow of relatively high velocity with surging flows and winnowing.

**Ravne3 Cavity fill – Log 2**
Location; Western side of filled cavity behind ‘C2’ blocking stone.




Unit thickness; 1.10 metres. Occurrence; Filling cavity space adjacent to valley edge.

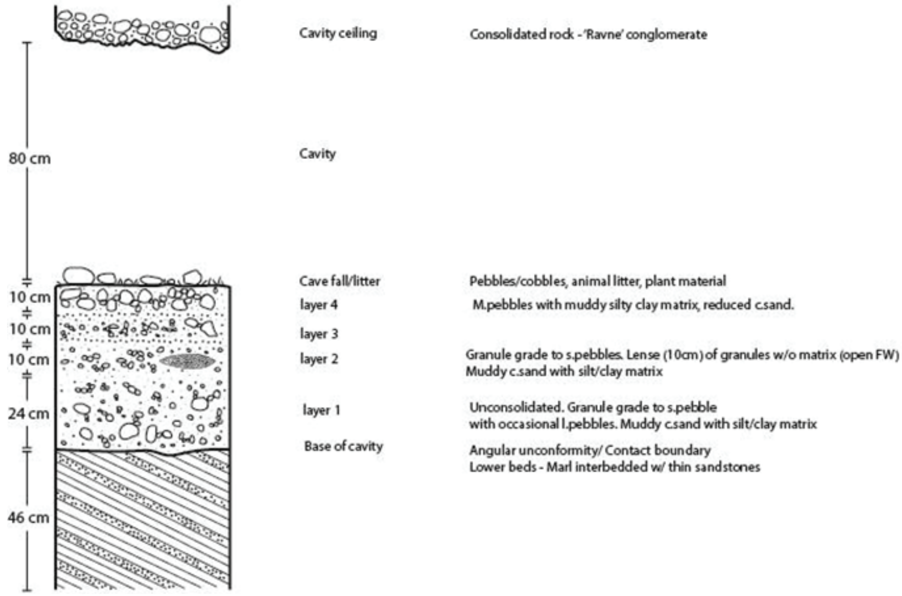
Clast composition; Consists of similar clasts in shape, size and composition to that found in Ravne conglomerate.

Matrix composition; Coarse sand with silt and clay components of allogenic matrix greater than that of consolidated Ravne conglomerate unit giving the material a muddier appearance and texture. No authigenic matrix is present. Material weakly reacts to HCl acid. Organic material (roots) are concentrated within specific horizons.

Fabric; Unit is unconsolidated and vaguely stratified. Layers are not laterally extensive (Less than 0.5 m) and become chaotic. Directly at log location two well defined grouped layers (1&2/ 4,5&6) can be made containing generally poorly sorted clasts. Individual layers within each set are diffusely stratified and show great lateral variability (greater than consolidated Ravne conglomerate). Stratified sets are divided by a thin bed of fine yellow clay (Layer 3) that is not laterally extensive. Well defined thin organic rich layers (7&9) that are also not laterally extensive rest above the clastic material.

Classification; Differentiated from the unconsolidated passage filling material (Log4) by the presence of crude stratification within the gravel beds but more notedly by the thin discontinuous interbeds of clay and organic rich material.
Interpretation; Anthropogenic. Soil material mixed with disaggregated Ravne conglomerate has been placed inside the cavity, partially filling it, in at least three phases (1-3, 4-9, topsoil & cave fall). Layers 7 to 9 may represent part of an old exposed surface now buried by the younger topsoil brought in to further fill the cavity. Presence of roots indicate this section of tunnels may have been exposed to the elements or was in proximity to a section that was.

**Ravne3 Cavity fill – Log 3**
Location; Western side of filled cavity behind 'C2' blocking stone




Unit thickness; 0.54 metres. Occurrence; Filling cavity space adjacent to valley edge.

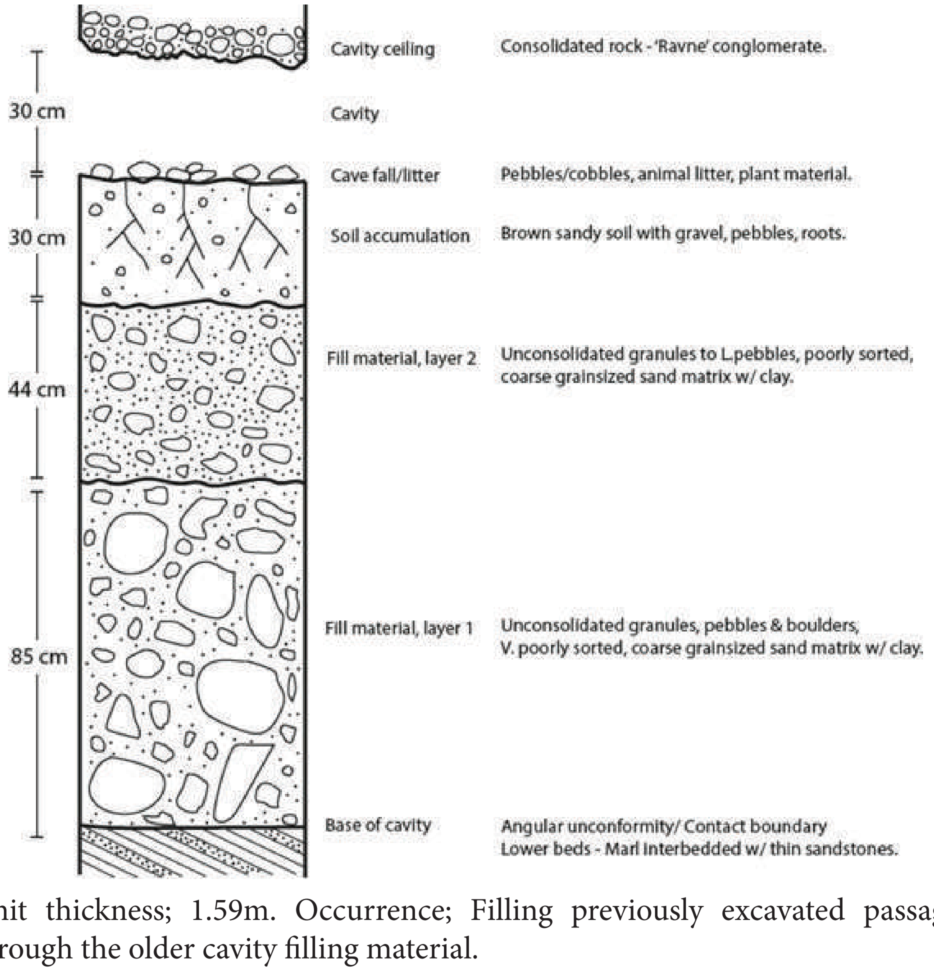
Clast composition; Consists of similar clasts in shape and composition to that found in Ravne conglomerate. Grade is generally much finer than is found in Log 2.

Matrix composition; Coarse sand with silt and clay components of allogenic matrix greater than that of consolidated Ravne conglomerate unit giving the material a muddier appearance and texture. No authigenic matrix is present. Material weakly reacts to HCl acid. Organic material (roots) are concentrated within specific horizons.

Fabric; Unit is unconsolidated and vaguely stratified. Layers are not laterally extensive (Less than 0.5 m) and become chaotic. Directly at log location two well defined grouped layers (1&2/ 4,5&6) can be made containing generally poorly sorted clasts. Individual layers within each set are diffusely stratified and show great lateral variability (greater than consolidated Ravne conglomerate). Stratified sets are divided by a thin bed of fine yellow clay (Layer 3) that is not laterally extensive. Well defined thin organic rich layers that are also not laterally extensive rest above the clastic material.

Classification; Cavity infill material
Interpretation; Anthropogenic in combination with natural accumulation over time through cave fall and exposure to outside elements. Represents at least one phase of purposeful cavity infill. Later phases seen in Log 2 have either been removed in an attempt to enlarge the blocked cavity space or this area of Ravne3 was never entirely blocked up to the conglomerate ceiling.

**Excavated passage filling material – Log 4**
Location; C3 entrance passage




Unit thickness; 1.59m. Occurrence; Filling previously excavated passage through the older cavity filling material.

Clast composition; Consists of similar clasts in shape and composition to that found in Ravne conglomerate. Grade is generally much coarser towards the base, with small boulders and cobble sized clasts.

Matrix composition; Coarse sand with silt and clay components.
Fabric; Unit is unconsolidated. Stratification is simple, with variability only being in clast size. Classification; Anthropogenic passage infill.

Interpretation; Represents the most recent cavity infill. Infills a previously opened route through the oldest cavity infill material, blocking access to the opened sections of Ravne3. Plant roots found only on the top soil horizon indicating the observed horizons are contemporary with each other as lower layers were never exposed to the elements allowing plant life to colonize. The plant roots also indicate material must have been put in situ more recently than other cavity fill material as growth does not go to any great depth beyond the first horizon. Large stones found at base due to selecting the biggest boulders and cobbles first in an attempt to fill cavity space as quickly as possible. Once larger clasts had been used, remaining space was filled up with the smaller remaining clasts.

# U-series dating report | Institute of Geology CAS

Work no.: 2019-SM Samples quantity: 1
Material: Stalagmite
Remarks: 4g of calcite powder selected from basal part of stalagmite S002. Sample marked as S002/B5

**Method description:**
***Chemical procedure of uranium and thorium separation***

After thermal decomposition of organic matter a 233U-236U-229Th spike is added to samples before any further chemical treatment. Calcite sample is dissolved in nitric acid. Uranium and thorium is separated from carbonate matrix using chromatographic method with TRU- resin Chemical procedure has been done in U-series Laboratory of Institute of Geological Sciences, Polish Academy of Sciences (Warsaw, Poland). Internal standard sample and blank sample were prepared simultaneously any series of studied samples.

**Measurement**
Isotopic composition of U and Th measurement has been performed in Institute of Geology of the CAS, v. v. i. (Prague, Czech Republic). Measurements were performed with a double- focusing sector-field ICP mass analyzer (Element 2, Thermo Finngan). The instrument was operated at a low mass resolution (m/ $\Delta m \geq 300$). Measurement results were corrected for counting background and chemical blank.

**Results:**

| Lab. no. | Sample | U cont. [ppm] | $^{234}U/^{238}U$ | $^{230}Th/^{234}U$ | $^{230}Th/^{232}Th$ | Age [ka] | Corrected age [ka] |
|---|---|---|---|---|---|---|---|
| 129 0 | S002/B5 | 0.0288±0.0001 | 1.279±0.004 | 0.077±0.002 | 2.53±0.08 | 8.8 ± 0.2 | 5.9 ± 0.3 |

Reported errors are 2 standard deviations.

**General remarks:**

Isotope of 232Th indicates the potential contamination of the sample by thorium and uranium from detrital source. The ages obtained were thus adjusted for detrital contamination indicated by the presence of 232Th using the typical silicate activity ratio 230Th/232Th of 0.83 (± 0.42) derived from the 232Th/238U activity ratio of 1.21 (± 0.6), 230Th/238U activity ratio of 1.0 (± 0.1) and 234U/238U activity ratio of 1.0 (± 0.1) (cf. Cruz et al., 2005).

Cruz Jr., F., W., Burns, S.J., Karmann, I., Sharp, W.D., Vulle, M., Cardaso, A.O., Ferrari, J.A., Dias, P.L.S., Vlana Jr., O., 2005. Insolation-driven changes in atmospheric circulation over the past 116,000 years in subtropical Brazil. Nature 434, 63–65.

Conventional radio carbon dating service laboratory. Kiev.

**Reporting of radiocarbon dating of findings.**

Samples.
See description of each sample in annexes.

Approach.

1. Seeking for measurable amount of organic matter.
2. Dating of carbonate.
3. Individual interest of each sample.

Methods.

Carbon dating technology used was based on conventional method i.e. use of liquid scintillation counting to benzene sample. Datable Carbon of each sample was converted to lithium carbide, than to acetylene and benzene. ( $C + Li > Li_2C_2 > C_2H_2 > C_6H_6$ ) Application of thermo-destruction technology to sample (vacuum pyrolysis) allows prepare counting media. In sample surface, containing organics, after thermos-destruction can be seen black dust (Carbon) of charred organics.

Acid destruction of carbonate allow conversion of carbonate to $CO_2$. Further reaction $CO_2$ with Li metal produces carbide. Future sample processing reactions according to underlined scheme above.

Results.

1. Required amount of material of samples C2-018 and C2-025 was dried at 250 degree Celsius for 3 hours. Each sample was then processed by thermo-destruction. No benzene was produced, neither traceable residual Carbon on surface. I.e. No Datable organic Carbon.

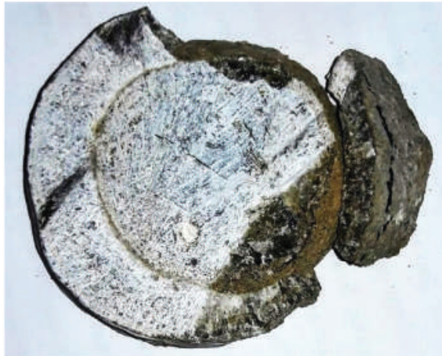
2. Acid destruction of carbonate for samples C2-018 and C2-025 allow us produce benzene samples, which then were dated (see protocols IHME-3733 and IHME-3735). Sandstone like material of C2-018 produce much more benzene comparing to C2-025 (like pressed clay).

3. Sample C2-024 look like bird bone, which was initially small (about 3.5 g), and processed accordingly including pretreatment. Here we use vacuum pyrolysis two stage procedure to analyze total datable Carbon of this sample. No benzene was produced, neither traceable residual Carbon on surface.

4. Stalagmite sample S001 was studied first, then cross-section was taken from bottom of it (thickness about 2.0 cm). It was divided for parts (A) external layer, and (B+C) – internal layer. See protocols IHME-3730, IHME-3729. Second cross-section (thickness about 2.0 cm) produce A layer similar to previous (51 g) and layers B and C, each around 40 g of material. Layer B sample was lost during of operation, when layer C sample produces protocol IHME- 3732. To look at layer B we make 3-rd cross-section, thickness about 1.5 cm (see figure 1). Here we find only top of B layer, covered by layer A, and we separated them. It was about 20 g of material in layer B. This sample produces protocol IHME-3734.

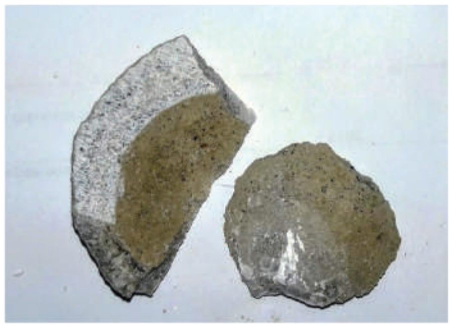
12.11.2018

Cross-section 1. Layers BC after A separated.



Cross-section 2. Layers A + BC.

Cross-section 3. Layers A + B.



Cross-section 3. Layers A + B, separated.

Figure 1. Photos of cross-sections analyzed for stalagmite sample S001.

Table 1. Radiocarbon dating of samples

| Lab N | Description | Benzene, g | pMC, % | Age, years (BP) |
|---|---|---|---|---|
| 3729 | S001 Layer ( B+C ) | 1,3853 | 64,5 | 3520±50 |
| 3730 | S001 Layer ( A ) | 0,694 | 72,9 | 2540±50 |
| 3732 | S001 Layer ( C ) | 1,2285 | 61,7 | 3880±55 |
| 3733 | S2-018 | 1,3183 | 68,3 | 3070±50 |
| 3734 | S001 Layer ( B ) A | 1,0192 | 3,8 | 26200±250 |
| 3735 | S2-025 | 0,149 | 26,7 | 10625±300 |

Annexes.

1. Sample descriptions. (4 pages)
2. Sample dating protocols. (7 pages

FONDACIJA ARHEOLOŠKI PARK: BOSANSKA PIRAMIDA SUNCA
ARCHAEOLOGICAL PARK: BOSNIAN PYRAMID OF THE SUN FOUNDATION

**Adresa:** Himze Polovine 12, 71000 Sarajevo
**Tel.** 033 259-935, **Fax:** 033 259 937
**Email:** info@piramidasunca.ba
**Web:** www.piramidasunca.ba

**Fondacija "Arheološki park: Bosanska piramida Sunca"** je neprofitna, nevladina i nepolitička organizacija registrovana za zaštitu kulturnog nasljeđa, arheološka iskopavanja, izdavačku djelatnost, organizaciju kongresa i promociju arheološkog turizma na teritoriji Bosne i Hercegovine. Dva projekta Fondacije su istraživanje i zaštita kompleksa piramida u visočkoj dolini i katalogiziranje fenomena prahistorijskih kamenih kugli širom BiH.

# SAMPLE FOR ANALYSIS

SAMPLE : C2-025

DESCRIPTION:

- Size ≈ 7 x 6 x 3 cm,
- Weight ≈ 170 g
- Finding date: 20.9.2018.
- Finding place: Ravne 3 tunnel, section C2.

NOTE: it could be organic material. If it is, we would like to make dating analysis for this sample.

For any additional qouestions of informations, please contact to:

Mejra Kozlo, field geologist

e-mail: mejra@piramidasunca.ba

tel: 00 387 62 088 572

**Raiffeisen Bank dd Sarajevo** Donatorski račun R.br. 161 000 000 000 0011 Svrha uplate: Donacija na račun R.br. 533711000-520000642 **KM**, R.br. 533712000-520000642 **EUR**, R.br. 533713000-520000642 **USD**
SWIFT:RZBABA2S

FONDACIJA ARHEOLOŠKI PARK: BOSANSKA PIRAMIDA SUNCA
ARCHAEOLOGICAL PARK: BOSNIAN PYRAMID OF THE SUN FOUNDATION

**Adresa:** Himze Polovine 12, 71000 Sarajevo
**Tel.** 033 259-935, **Fax:** 033 259 937
**Email:** info@piramidasunca.ba
**Web:** www.piramidasunca.ba

**Fondacija "Arheološki park: Bosanska piramida Sunca"** je neprofitna, nevladina i nepolitička organizacija registrovana za zaštitu kulturnog nasljeđa, arheološka iskopavanja, izdavačku djelatnost, organizaciju kongresa i promociju arheološkog turizma na teritoriji Bosne i Hercegovine. Dva projekta Fondacije su istraživanje i zaštita kompleksa piramida u visočkoj dolini i katalogiziranje fenomena prahistorijskih kamenih kugli širom BiH.

## SAMPLE FOR ANALYSIS

SAMPLE : S001

DESCRIPTION:

- Height ≈ 10 cm,
- Weight ≈ 905 g
- Diameter ≈ 9 cm
- Finding date: 18.9.2018.
- Finding place: Ravne 3 tunnel, section C3, aproximately 43 m from the entrance.

NOTE: Stalagmite - we would like to make dating analysis for this sample.

For any additional qouestions of informations, please contact to:

Mejra Kozlo, field geologist

e-mail: mejra@piramidasunca.ba

tel: 00 387 62 088 572

**Raiffeisen Bank dd Sarajevo** Donatorski račun R.br. 161 000 000 000 0011 Svrha uplate: Donacija na račun R.br. 533711000-520000642 **KM**, R.br. 533712000-520000642 **EUR**, R.br. 533713000-520000642 **USD**
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# SAMPLE FOR ANALYSIS

SAMPLE : C2-024

DESCRIPTION:

- Length ≈ 6 cm,
- Diameter ≈ 0,9 cm
- Weight ≈ 3,5 g
- Finding date: 20.9.2018.
- Finding place: Ravne 3 tunnel, section C2.

NOTE: it could be organic material. If it is, we would like to make dating analysis for this sample.

For any additional qouestions of informations, please contact to:

Mejra Kozlo, field geologist

e-mail: mejra@piramidasunca.ba

tel: 00 387 62 088 572

**Raiffeisen Bank dd Sarajevo** Donatorski račun **R.br. 161 000 000 000 0011** Svrha uplate: Donacija na račun R.br. 533711000–520000642 **KM**, R.br. 533712000–520000642 **EUR**, R.br. 533713000–520000642 **USD**
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# SAMPLE FOR ANALYSIS

SAMPLE : C2-018

DESCRIPTION:

- Size ≈ 10,5 x 11,5 cm,
- Weight ≈ 240 g
- Finding date: 18.9.2018.
- Finding place: Ravne 3 tunnel, section C2.

NOTE: It could be petrified wood. If it is we would like to make dating analysis for this sample.

For any additional qouestions of informations, please contact to:

Mejra Kozlo, field geologist

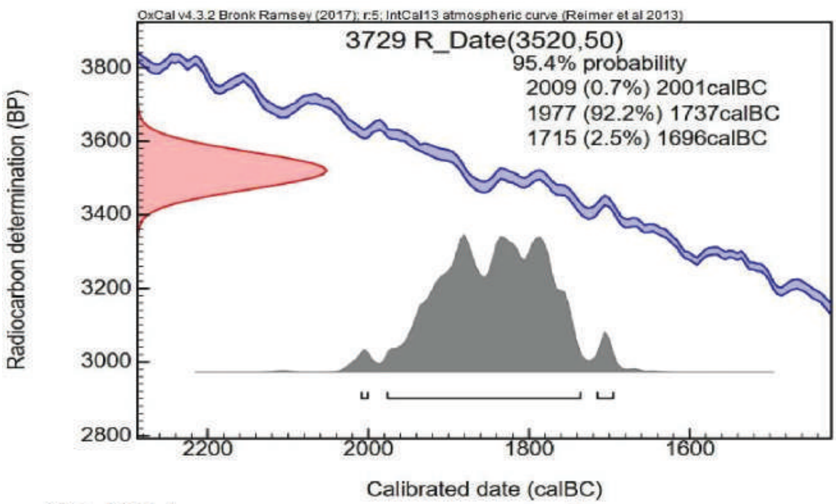
e-mail: mejra@piramidasunca.ba

tel: 00 387 62 088 572

**Raiffeisen Bank dd Sarajevo** Donatorski račun R.br. **161 000 000 000 0011** Svrha uplate: Donacija na račun R.br. 533711000-520000642 **KM**, R.br. 533712000-520000642 **EUR**, R.br. 533713000-520000642 **USD**
SWIFT:RZBABA2S

Conventional radio carbon dating service laboratory. Kiev.

| Радіовуглецева дата (Radiocarbon date) | | |
|---|---|---|
| Замовник(Customer) | Foundation "Archaeological park | "Bosnian Pyramid of the Sun" |
| Зразок(Sample): | Sample S001 | (Carbonate, Layers B+C) |
| Код лабораторії (lab code) | IHME-3729 | |
| Маса бензолу (benzene mass) | 1,3853 | грам (g) |
| Час вимірювання (counting time) | 3000 | хвилин (minutes) |
| Швидкість лічення проби (Sample count rate) | 8.870 | CPM |
| Фон (імп./хв.) (Background count rate) | 0.546 | CPM |
| Ефективність реєстрації (counting efficiency) : | 73,61% | Процент (percent) |
| Радіовуглецева дата (Radiocarbon date) | 3520 ± 50 | BP |




Michael G.Buzinny

12.11.2018

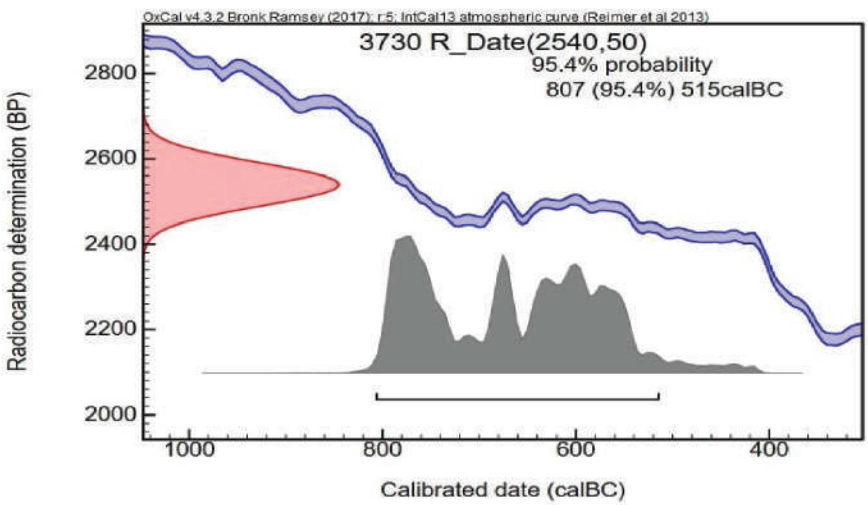
mbuz@ukr.net,
http://c14.kiev.ua

Калібрована дата (Calibrated date) Below

Conventional radio carbon dating service laboratory. Kiev.

| | | |
|---|---|---|
| Замовник(Customer) | Foundation "Archaeological park | "Bosnian Pyramid of the Sun" |
| Зразок(Sample): | Sample S001 | (Carbonate, Layer A) |
| Код лабораторії (lab code) | IHME-3730 | |
| Маса бензолу (benzene mass) | 0,694 | грам (g) |
| Час вимірювання (counting time) | 3000 | хвилин (minutes) |
| Швидкість лічення проби (Sample count rate) | 5.211 | CPM |
| Фон (імп./хв.) (Background count rate) | 0.506 | CPM |
| Ефективність реєстрації (counting efficiency) : | 73,51% | Процент (percent) |
| Радіовуглецева дата (Radiocarbon date) | 2540 ± 50 | BP |
| Калібрована дата (Calibrated date) | | |

Below

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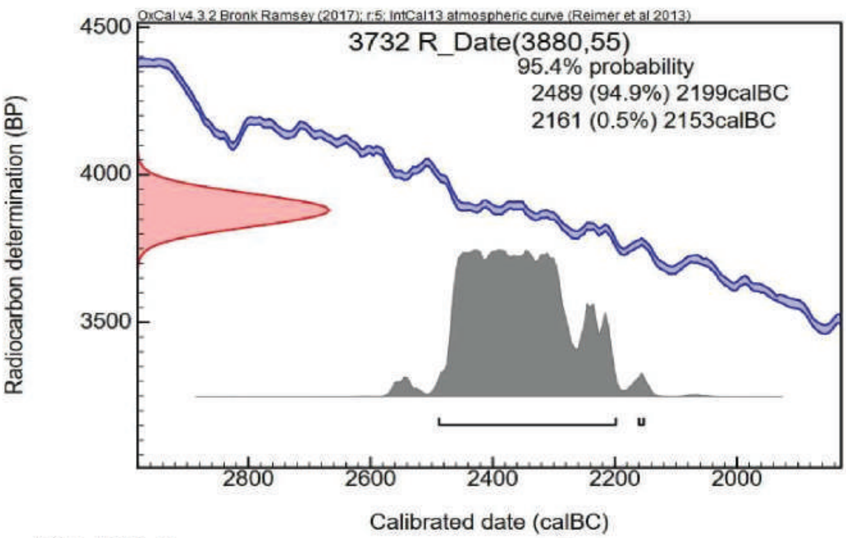
Conventional radio carbon dating service laboratory. Kiev.

| | | | |
|---|---|---|---|
| Замовник(Customer) | Foundation "Archaeological park | "Bosnian Pyramid of the Sun" | |
| Зразок(Sample): | Sample S001 | (Carbonate, Layer C) | |
| Код лабораторії (lab code) | IHME-3732 | | |
| Маса бензолу (benzene mass) | 1,2285 | грам (g) | |
| Час вимірювання (counting time) | 3000 | хвилин (minutes) | |
| Швидкість лічення проби (Samplecount rate) | 7.609 | CPM | |
| Фон (імп./хв.) (Background countrate) | 0.546 | CPM | |
| Ефективність реєстрації (countingefficiency) : | 73,61% | Процент (percent) | |
| Радіовуглецева дата (Radiocarbondate) | <u>3880 ± 55</u> | <u>BP</u> | |

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12.11.2018

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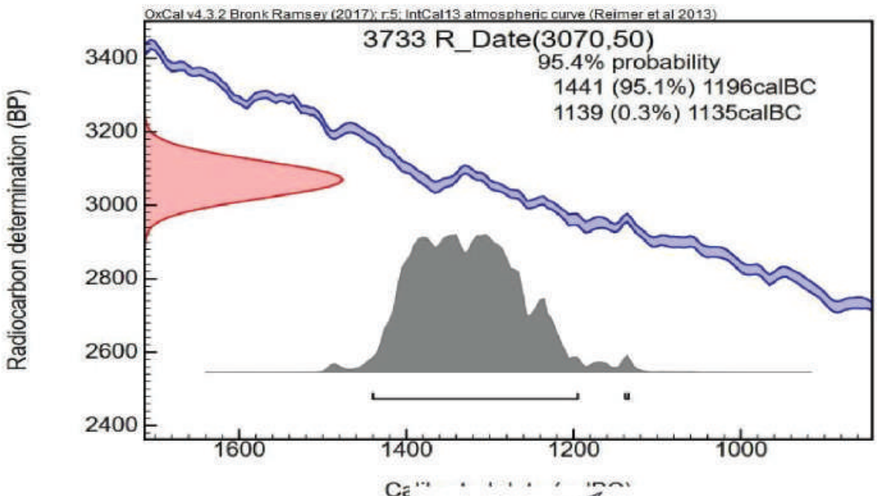
Conventional radio carbon dating service laboratory. Kiev.

| | | |
|---|---|---|
| Замовник(Customer) | Foundation "Archaeological park | "Bosnian Pyramid of the Sun" |
| Зразок(Sample): | Sample S2-018 | (carbonate, like sandstone) |
| Код лабораторії (lab code) | IHME-3733 | |
| Маса бензолу (benzene mass) | 1,3183 | грам (g) |
| Час вимірювання (counting time) | 3000 | хвилин (minutes) |
| Швидкість лічення проби (Sample count rate) | 8.878 | CPM |
| Фон (імп./хв.) (Background count rate) | 0.506 | CPM |
| Ефективність реєстрації (counting efficiency) : | 72,61% | Процент (percent) |
| Радіовуглецева дата (Radiocarbon date) | 3070 ± 50 | BP |
| Калібрована дата (Calibrated date) | Below | |

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Conventional radio carbon dating service laboratory. Kiev.

| Замовник(Customer) | Foundation "Archaeological park | "Bosnian Pyramid of the Sun" |
|---|---|---|
| Зразок(Sample): | Sample S001 (layer B, top) | (carbonate) |
| Код лабораторії (lab code) | IHME-3734 | |
| Маса бензолу (benzene mass) | 1,0192 | грам (g) |
| Час вимірювання (counting time) | 3000 | хвилин (minutes) |
| Швидкість лічення проби (Sample count rate) | 0,87 | CPM |
| Фон (імп./хв.) (Background count rate) | 0,506 | CPM |
| Ефективність реєстрації (counting efficiency) : | 73,51% | Процент (percent) |
| Радіовуглецева дата (Radiocarbon date) | 26200 ± 250 | BP |
| Калібрована дата (Calibrated date) | - | |

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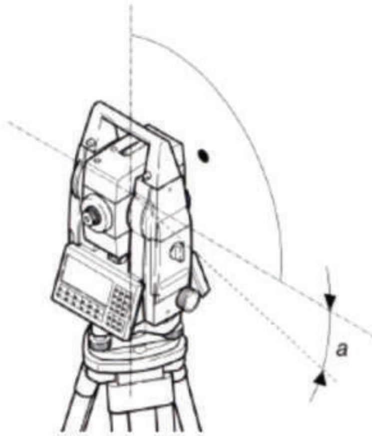
# RAVNE TUNNELS COMPLEX

## SUBTERRANEAN SURVEY

## 2020




Bosnian Valley of the Pyramids

Visoko, Bosnia

Report by Richard Hoyle
BPS Foundation Field Geologist

# Subterranean Survey - Ravne Tunnels Complex, 2020

In winter of 2020, The Bosnian Pyramid of the Sun Foundation undertook a comprehensive survey of the underground Ravne Tunnels Complex. Principle personnel of the Foundation conducting the survey was field geologist Richard Hoyle and field archaeologist Amna Agić. Brought onboard for this research task was Tarik Harbaš, of the Geodetic Services Agency 'Survey Wizards', bringing with him 17 years' worth of vital professional surveying experience.

The purpose of the survey was to create an accurate map of each excavated tunnel section with the dimensions, position and orientation of features inside the tunnels being recorded. Tunnel junctions & major meeting points, chambers, channelized water sections and archaeological materials such as drywall constructions were all surveyed and included in the maps.

Many passages inside the Ravne Tunnels remain unexcavated. The production of an accurate map showing the position and general heading of each unexcavated passage will assist in future work, helping to decide which passages should receive excavation priority. Knowing the geodetic position of each tunnel will also allow for knowing what topographic and manmade features exist above the tunnels, upon the surface.

The production of an accurate Ravne Tunnels Complex map is also an invaluable resource for understanding if there are any underlying design principles determining the routes of the tunnels, or whether their directions are random. The surveyed layout of the passages may also provide researchers clues as to the motivation and original practical purpose of the tunnels at Ravne.

3D landscape render showing spatial relationship between the Bosnian Pyramid of the Sun and the Ravne Tunnels, located approximately 2.5km northwest of the pyramid.

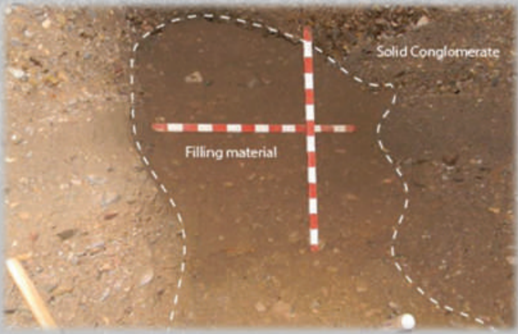
Photo by Haris Delibaši

## Ravne Tunnels Overview

The Ravne Tunnels complex is located beneath several small settlements on the outskirts of the central Bosnian town of Visoko. What is now the principle way of access into the tunnels, was first discovered by Dr Sam Osmanagich in 2006, 2.5km northwest from the Bosnian Pyramid of the Sun. Dr Osmanagich was, at that time, searching locally for underground passages that could potentially be associated with the nearby Bosnian Pyramids. When he made his discovery, the scale and complexity of the tunnel network was unknown. Prior to 2006, the entrance into the Ravne Tunnels was believed to be nothing more than a small cave. Upon removal of accumulated cave-fill by work crews of the Bosnian Pyramid of the Sun Foundation, Dr Osmanagich discovered a small passageway at the rear wall of the cave. This passageway had been blocked up with loose unconsolidated rubble and so Dr Osmanagich began working on removal of this material. As more and more material was removed from this passage, it soon became clear that there was not just one single passage existing, but many, with passages leading to yet more passages, and then some more, and more, heading deeper underground in all manner of directions. From Dr Osmanagich's inspection of a small cave, to a single passageway, to several passages, to something truly labyrinthian, the Ravne Tunnels has now become a remarkable and historic archaeological discovery.

## Geological Remarks

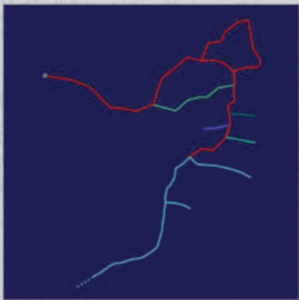
The Ravne Tunnels have been cut through a single geological bed composed of a rock type called a 'conglomerate'. This is a rock composed of other, older rocks that have been eroded over time by water, into rounded pebbles, cobbles and small boulders. These eroded rocks, or clasts, are deposited together, with clays and sands between them, by strong flowing currents of water, such as by a river, gradually over time, or rapidly by a single powerful event such as a flood. The Ravne Conglomerate is relatively young geologically speaking and has always remained as a near-surface deposit, never reaching depths within the Earth where it would be exposed to high pressures and high temperatures. Because of this fact, the constituent parts of the Ravne Conglomerate are held together rather weakly by the geologically recent onset of cementation. This cementation occurs when groundwater percolating through the rock deposits dissolved calcium carbonate between the pores of the conglomerate, solidifying the clasts together. In the case of the Ravne Conglomerate being so young, cementation is at a minimum and so to dislodge material from the rock takes little effort, but... don't let that fact fool you. To dig through the Ravne Conglomerate and remove the material to create the massive Ravne Tunnels Complex would be an enormous endeavour for anyone at any time. To complicate things further, after those tunnels were created, they were also filled back up, almost completely. Since 2006, the Bosnian Pyramid of the Sun Foundation has been continuously emptying the tunnels of this loose filling material, and still, the majority of the tunnels so far discovered still remain blocked up.




Left; Photo shows one of the Ravne Tunnels with its 'filling material' still in place. This material, unlike the conglomerate walls of the passage, is loose and will easily fall away from the tunnel sides. Note the colour difference between the conglomerate and filling material.

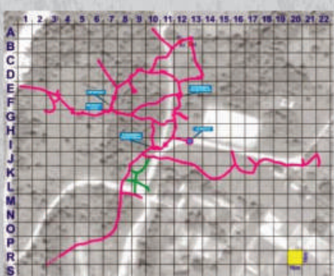
## Previous mapping of Ravne Tunnels

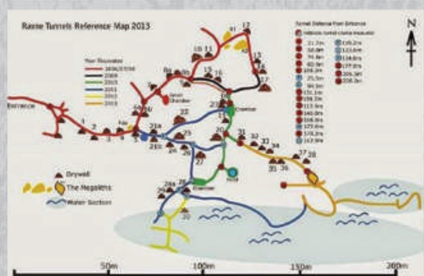
Since the initial discovery of the Ravne Tunnels, several attempts have been made to produce an accurate and detailed map of the subterranean passages. As the Ravne Tunnels are being excavated and the total length of traversable passages increase, so too the complexity of the network, and therefore the greater the number of man-hours is required to produce a high-quality map. Due to the inherent difficulties present when working in constrictive spaces underground, working on an active archaeological site and working on a site that at the same time is open to the visiting public, the success of previous attempt has been varied, each with their own strengths and weaknesses.




Above Left; A simple map produced in 2010 shows the main excavated thoroughfares. The passages are mapped with suitable accuracy and it also shows part of the unblocked water sections discovered the same year the map was produced. The map does however lack any detail on the position of side tunnels still infilled, drywalls or other points of interest (K1-K4 megaliths, Egg etc). Map is colour-coded to indicate the years each section was excavated.

Above Right; A more detailed map was produced in 2011, with tunnel dimensions also included. The producers of this map have also made an effort to include at least a few of the POI's, major drywalls and side tunnels located along the main thoroughfare. Due to time constraints however, many features still remain unrecorded. Inaccessibility of the water tunnel sections has discouraged an attempt to include those parts of the tunnels on this map.






Above Left; This map was produced in 2012 and shows how exploration of the Ravne Tunnels progressed rapidly over the course of two years. Various points of interest have also been included, however, tunnel dimensions and the position of side tunnels and drywalls are again missing. A colour coded version of this map also exists, indicating the years each section was excavated.

Above Right; Produced in 2013, this map utilized the 2012 map as a base and was extended. This is the first map to attempt a comprehensive survey of each drywall and side tunnel along the main thoroughfare. Newly excavated sections, side tunnels and drywalls were added. A manual mapping technique with compass and tape measure to locate the drywalls was used therefore errors in accuracy will be present. It contains a section of water tunnels not included on previous mapping projects but is missing the southwest water tunnel section recorded on the 2010 & 2012 maps. This map, like the 2012 map it is based on, does not show true tunnel dimensions.


## RAVNE TUNNELS SURVEY; 2020

Ravne Tunnels Complex, Bosnian Valley of the Pyramids,
Visoko, Central Bosnia

### Personnel;

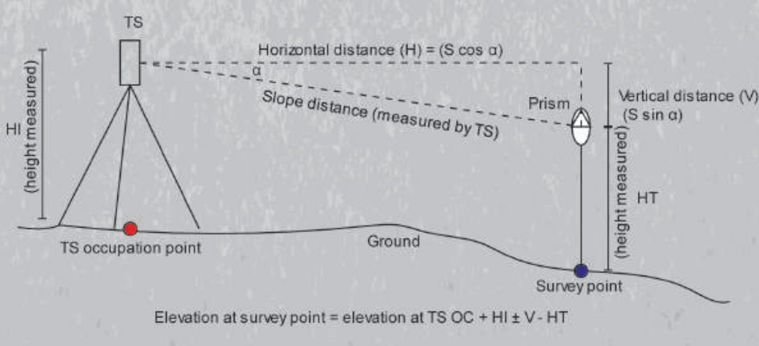
Project leader; Dr Sam Osmanagich, anthropologist
Project coordinator; Richard Hoyle, field geologist
Technical; Tarik Harbaš, geodesist
Field archaeologist; Amna Agić
Field support; Mejra Kozlo, geologist

### Equipment; (Below, left to right)

Total Station, model; Topcon GTS 105N
Trimble 5700 GPS receiver
TS tripod (Not shown)
Nikon AK19 retroreflector prism
Suunto MC-2 compass/clinometer
FERM laser distance meter


### Methodology;

The survey was principally conducted using the total station in conjunction with a retroreflector prism. A Total Station (TS) is an electronic theodolite with a built-in electronic distance measurement unit (EDM) that is used to measure vertical & horizontal angles and distance between the instrument's optical lens and the prism, which is placed at a selected survey point. The prism is held vertically at a known height above a survey point while the TS fires pulsed laser light towards it. The light is reflected back to the instrument via the prism held at the survey point. The TS on-board computer measures the time-of-flight of the pulse and, by multiplying that by the speed of light and dividing the result in half, the slope distance can be accurately calculated. The onboard computer performs real-time triangulation calculations between survey points and stores the raw collected data. Further processing of this data with desktop GIS & design software e.g. QGIS, AutoCAD, enables the creation of 2D maps of the tunnels.




Elevation at survey point = elevation at TS OC + HI ± V - HT

A plane surveying method using the cartesian coordinate system was employed for the survey. Curvature of the Earth was ignored as the total survey surface area was relatively small (0.21 sq. km).

Three arbitrary geodetic reference control points were created using the GPS receiver outside of the Ravne Tunnels. Each point provided a datum of known elevation, latitude & longitude at a far greater accuracy than the appropriate standard of measurement for the 1:500 survey scale chosen (permissible error ratio allows for details to be measured to the nearest 100mm). These points were then used for triangulating the position of the entrance/exits of each tunnel section (Ravne, Ravne3, Ravne4 etc). Total Station occupation points (TS OC) were created inside the tunnels in a bread-crumb fashion, placed at the centreline of the passages at strategic locations such as at a turning point or major junction where three or more passages meet. An open traverse was used, ending at the farthest reaches of the known tunnels. Along the traverse, the TS OCs were marked with a metal pin placed into the ground for use during the active survey and for referral in future work. Survey points using the prism were measured along the walls of the tunnels to determine the width of the passages and drywalls. Change of elevation along the tunnel floor was recorded but the height of each tunnel sections ceiling was not within the scope of this survey.

In sections of the tunnels where it was impractical for the total station to be used safely and effectively, e.g. narrow/low passages & flooded channelized water sections, a manual mapping methodology was adopted. Using a compass for orientation and a laser measuring meter for distance, these manually mapped sections of the tunnels were measured from the nearest pinned station.

Above left; Total Station inside the Ravne Tunnels levelled above a TS occupation point along the traverse of the passage. Above right; Total Station above one of three outside GPS reference control points. Below left; Prism retroreflector being held vertical at a known height above one of the GPS reference control points. Below right; TS targeting the retroreflector outside the Ravne3 Tunnels entrance.

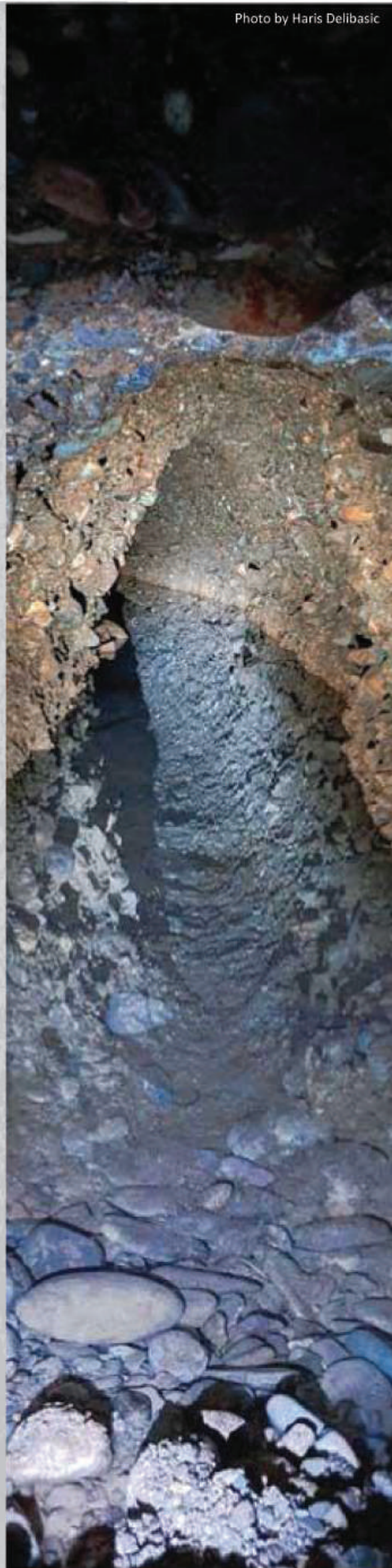
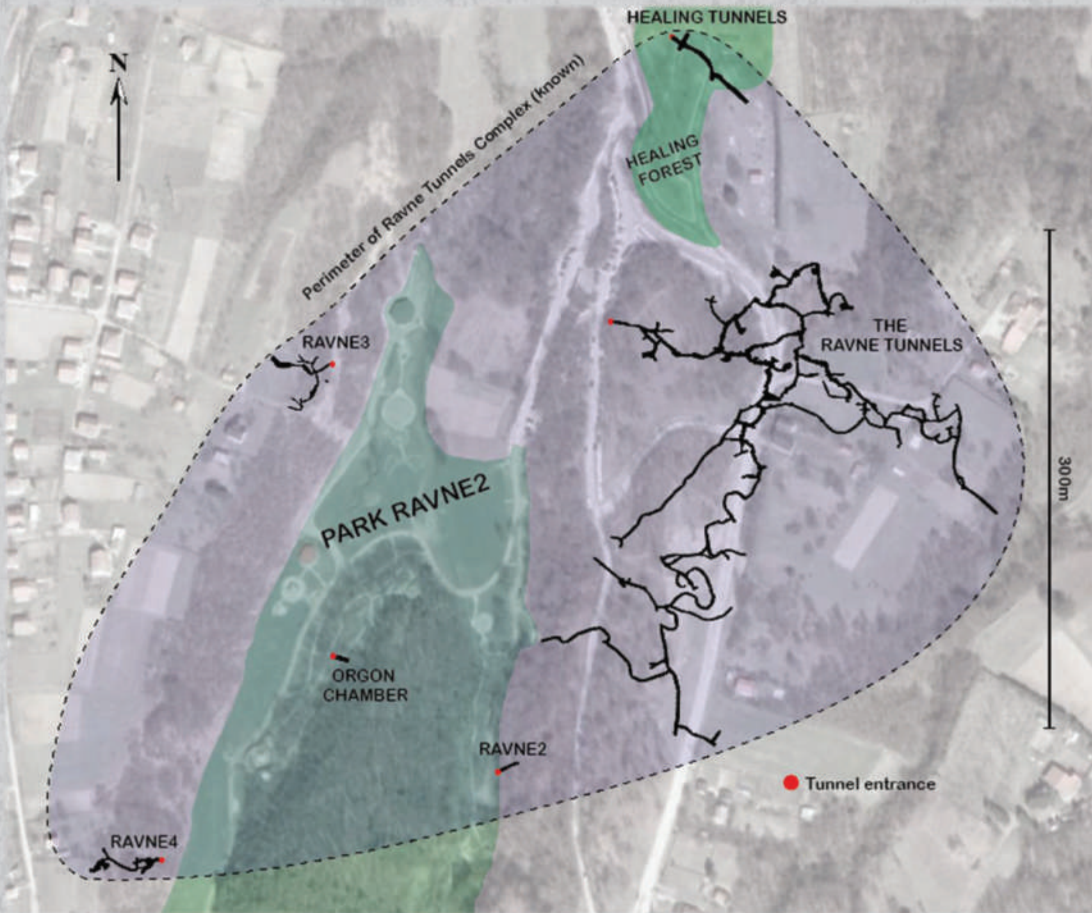
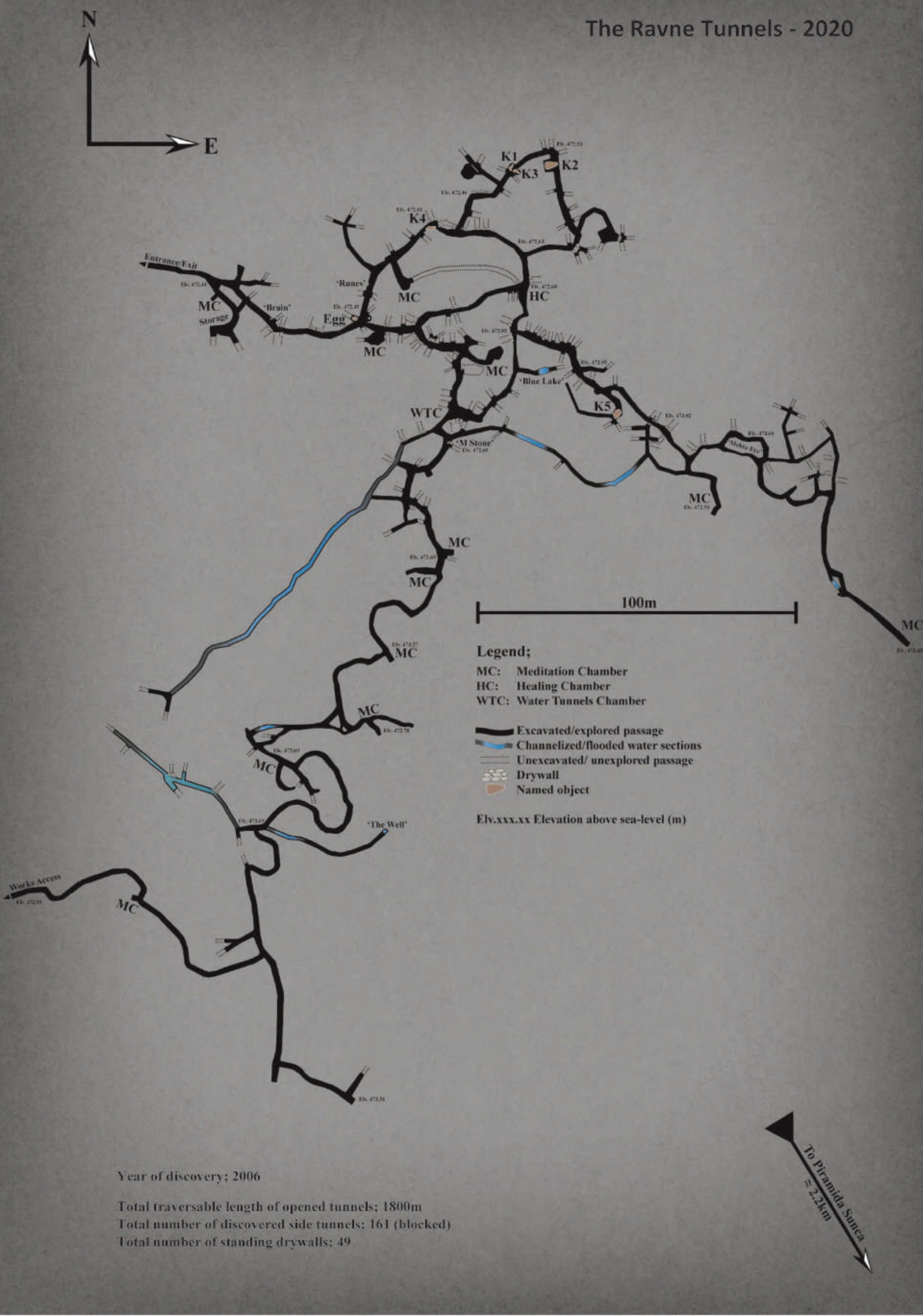


Photo by Haris Delibasic




The known extent of the Ravne Tunnels Complex has a total surface area estimated to be approximately 214, 430 Sq. m, with a perimeter of just over 1.8km.

Ravne2 Park occupies the low ground between the east and west sides of a small valley. Climbing steps towards Ravne3 excavation site seen centre-left. Looking north.


The Ravne Tunnels - 2020
N
E
Entrance/Exit
MC
Storage
'Brain'
Egg
'Runes'
MC
MC
K4
K1
K3
K2
HC
MC
'Blue Lake'
K5
WTC
'M Stone'
'Mehta Eye'
MC
MC
MC
MC
MC
MC
MC
'The Well'
Works Access
MC
100m
Legend;
MC: Meditation Chamber
HC: Healing Chamber
WTC: Water Tunnels Chamber
Excavated/explored passage
Channelized/flooded water sections
Unexcavated/ unexplored passage
Drywall
Named object
Elv.xxx.xx Elevation above sea-level (m)
Year of discovery; 2006
Total traversable length of opened tunnels; 1800m
Total number of discovered side tunnels; 161 (blocked)
Total number of standing drywalls; 49
To Piramida Sunca
≈ 2.2km

One of the passages within the Ravne Tunnels found to contain no loose rubble material, usually blocking access. These sections of tunnels are often found deep within the tunnel network, discovered only after years of excavation and removal of rubble from the adjoining blocked passages. Their shape, form and dimensions are original and have remained unchanged since the Ravne Tunnels were blocked up in the distant past. The dimension of the above tunnel is h.100cm x w.135cm.

The passage above measures h.100cm x w.100cm. All passages within the Ravne Tunnels run parallel with the approximately horizontal geological contact boundary below. The tunnels are naturally ventilated and whilst it is not completely understood how this natural ventilation occurs, it may be a product of the changing passage dimensions, forcing air exchange between high-pressure and low-pressure sections of the tunnels. The temperature gradient with the outside air does not affect the airflow, with ventilation occurring both in summer and winter.

Above is a much larger passage, measuring h.220cm x w.180cm. Passage dimensions change throughout the Ravne Tunnels and it may have been intentionally built as such. The larger volume of this passage will produce a section of slightly lower-pressure atmosphere than in the two passages in the above photos. Air therefore may flow from the higher-pressure atmosphere of the smaller, constrictive passages, into the larger, less restrictive tunnel sections, thus passively ventilating the entire Ravne Tunnels network. Air quality is measured regularly within the tunnels and it is not unheard of for oxygen levels to be higher inside the passages than outside in the countryside air. How this is possible has yet to be determined. It is important to note here that negative oxygen ion concentrations have also been measured to be consistently much greater inside the tunnels than outside. Breathing air found within the Ravne tunnels has the positive benefit of increasing the negative ion concentrations within the body's bloodstream. Besides negative ions clearing dust, airborne allergens, bacteria and viruses from the air through nucleation, ongoing medical research has attributed negative ions with numerous beneficial health effects on the human physical and mental condition.

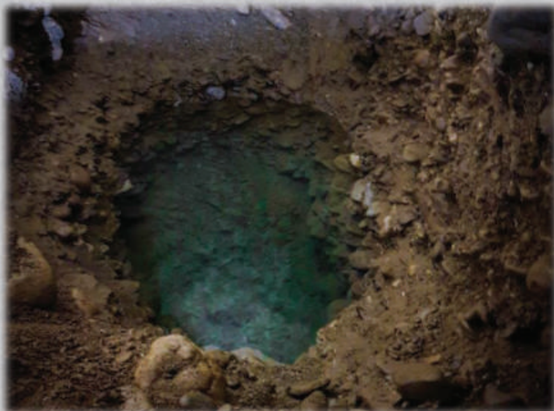
One of the flooded water sections of the Ravne Tunnels. This water section is south of the 'blue lake'. The placid water is captured within the tunnels due to the underlying geological layers being impermeable. The water contained within the Ravne Tunnels has slowly permeated through the surrounding conglomerate rock, which contains fine carbonaceous clays, sands and pebbles. These materials filter out impurities from the water, leaving it crystal clear and perfectly fit for human consumption.

Above is a small widened chamber containing captured water, named 'Blue Lake'. It measures *l*.5m x w.1.6m. Towards the rear of the chamber is a passage infilled with loose, unconsolidated rubble. This blocked passage will connect with one of the infilled side tunnels located along the thoroughfare heading southeast, north of the 'Blue Lake'.

Photo by Sara Acconci

The above photo shows part of the longest water tunnel section, which runs southeast for almost 200m. It can be seen that this passage has been channelized along its centreline. This open section of tunnels was first accessed and explored towards the closing of 2010 when excavations reached the meeting point of several passages, now named the 'Water Tunnels Chamber'.

This flooded section is over 50m long and its dimensions are h.110cm x w.100cm. Some water droplets, when percolating through the conglomerate, may split apart upon impact with the surface of the rocks. This agitation causes the droplets to lose electrons and become positive ions. The surrounding oxygen may absorb those electrons and become negative ions. This phenomenon is known as the 'Lenard Effect' and may explain the high concentration of negative ions within the tunnels.



This depression in the tunnel floor found to contain crystal clear water is located at the end of one of the unblocked passages, towards the southeast extent of the Ravne Tunnels. It has been named 'The Well'. It measures *l*.150cm x w.100cm and is 40cm deep. By its appearance, this feature was likely intentionally placed at the end of the passage but its purpose has yet to be fully understood.

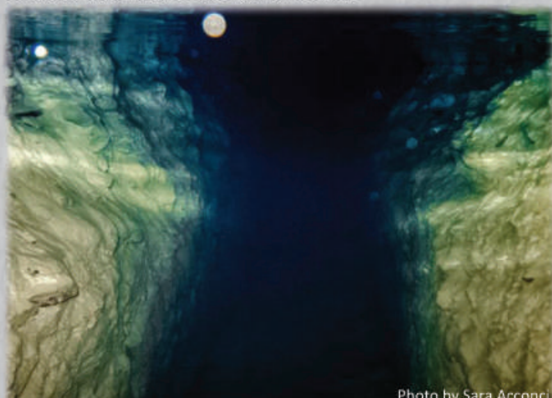


Photo by Sara Acconci

Above is an underwater photograph of the channelized water tunnel. The channel is well defined with straight vertical edges and has been cut down into the impermeable marl layers underlying the conglomerate above. The channelization suggests that, at least this part of the tunnels, may have been constructed to function as an underground aqueduct or cistern, collecting and then directing groundwater to a specific location.

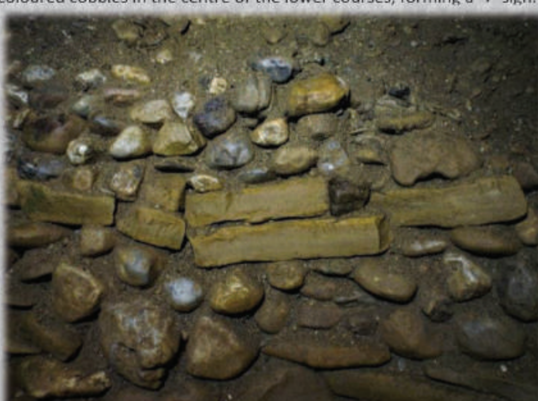
There are at least 48 drywalls that have been excavated within the Ravne Tunnels that remain intact. Some drywalls were deconstructed in order to extend the traversable distance within the tunnels. Many more drywalls remain undiscovered, still buried within unexcavated passages. The drywall above measures h.43cm x w.180cm, is 5-6 courses high and is representative of the majority of drywalls within the Ravne Tunnels.

The drywall above measures h.88cm x w.150cm and is 7 courses high. Usually, each drywall marks the location of an intersection between two infilled passages, with the drywall becoming visible after removal of loose rubble from one of the passages. The drywalls function as both a marker for another passage and as a retaining wall, holding the loose rubble in place within each infilled passage section.

The drywall above measures h.70cm x w.114cm and is 6 courses high. This particular drywall is unique to those presently discovered due to its strong convex curvature. It is located along the passage between K4 and the 'Healing Chamber'. Another uncommon feature it shares with several other drywalls is the flat faced slab placed in the centre of the drywall. This may indicate some of the drywall builders considered both practical function as well as the aesthetic value of their constructions.

The drywall above measures h.110cm x w.155cm and is 10 courses high, making it one of the tallest drywalls within the Ravne Tunnels. It is located along the passage between the 'Healing Chamber' and the 'Blue Lake. This drywall is also one of the more artistically constructed. With a central flat slab, as seen in the previously mentioned drywall, it also uses colour from different rock compositions in its design. Note the four light coloured cobbles in the centre of the lower courses, forming a '+' sign.


The drywall above measures h.125cm x w.300cm and is 12 courses high, making it one of the widest drywalls discovered within the Ravne Tunnels. The drywall displays an arrangement of several flat slabs within its centre. Another unique feature of this wall is the use of two cobbles at each end of the wall that have a surface texture that condenses water upon their surfaces, giving them a wet reflective sheen not seen on any other stone.



Above is the arrangement of the slabs within the centre of the wall seen [left]. In the middle are two slabs above one another. The slab above has a slightly convex face, while the larger slab below has a concave curvature to it. Whether or not these various small design cues seen across several of the drywalls have a symbolic significance or if they are representative of the constructers creative flare only, has yet to be determined.

The most substantial and impressive drywalls discovered across the entire Ravne Tunnels Complex are located along and nearby the southwest trending 'Water Tunnel'. Unlike in any other accessed tunnel sections, some of the drywalls here are seen bracing the passage sides, with no indication of side tunnels behind them. Unfortunately, due to inaccessibility, it is often difficult to inspect these drywalls closely.

The drywall above is captured coming into view on the right-hand side of the photo, left. The drywall is composed of cobbles of varying composition, with a smoothly polished black basalt cobble in its centre. This cobble type is rather uncommon within the Ravne conglomerate and has not been noted in use within any other drywall. The drywalls in this section of tunnels often climb the entire passage height of the main thoroughfare.


The 'Egg Shaped Monolith' was one of the first unusual features identified within the Ravne Tunnels. The Egg is composed of material unlike any of the clasts contained within the Ravne conglomerate and has been estimated to weigh approximately 350kgs. The Egg and its two smaller companions are positioned in such a way that they are pointing towards the direction an adjacent side tunnel is leading towards.

Photo above shows another unusual object identified within the Ravne Tunnels, named 'K1 Megalith'. This object is 2.5m long and estimated to weigh approximately 3 tonnes. It has been reported to have been found with suspected proto-runic inscriptions adorned upon its otherwise smooth surface. Its composition matches that of the 'Egg Shaped Monolith', but its shape is significantly different.

Found towards the most northern part of the explored passages, the photo above shows the largest single object identified within the Ravne Tunnels, the 'K2 Megalith'. It is similar in composition to both the 'Egg' and 'K1' and is, just as the previously aforementioned objects, found out-of-context, in shape, size and composition, with the surrounding geological material.

The photo above shows the underside of the 'K2 Megalith'. The object is resting on several smaller stone blocks beneath it, which combined, act as a supporting plinth for the megalith. Intersecting underground waterflows have been detected beneath the megalith, suggesting its placement was purposeful and deliberate. 'K2' has been estimated to weigh approximately 8 tonnes.

The photo above shows the first chamber of Ravne3 Tunnels (R3-1), taken shortly after discovery. This section of tunnels was found completely free of any blocking material. The raised floor (20-30cm) contained over 1000 artefacts from various archaeological time periods, including the Neolithic, Roman, and Medieval periods. Artefact types included pottery fragments, bronze jewellery, coins and metallic tools. This discovery marked the highest concentration of finds ever made within the Ravne Tunnels Complex. Chamber is l.10m x w.3m x h.1.8 m.

Seen here is a straight passage connecting the two main chambers discovered in Ravne3. Again, this section was also found to contain no blocking material and some artefacts buried within its raised floor. The passage is 10m long and 175cm wide. Towards the end of the passage, where it conjoins with the largest chamber (R3-2), were found a swarm of stalagmites. U-Th radiometric dating gave a minimum age for the formation of the stalagmite tested at approximately 6000 years, therefore the tunnels themselves must be older.

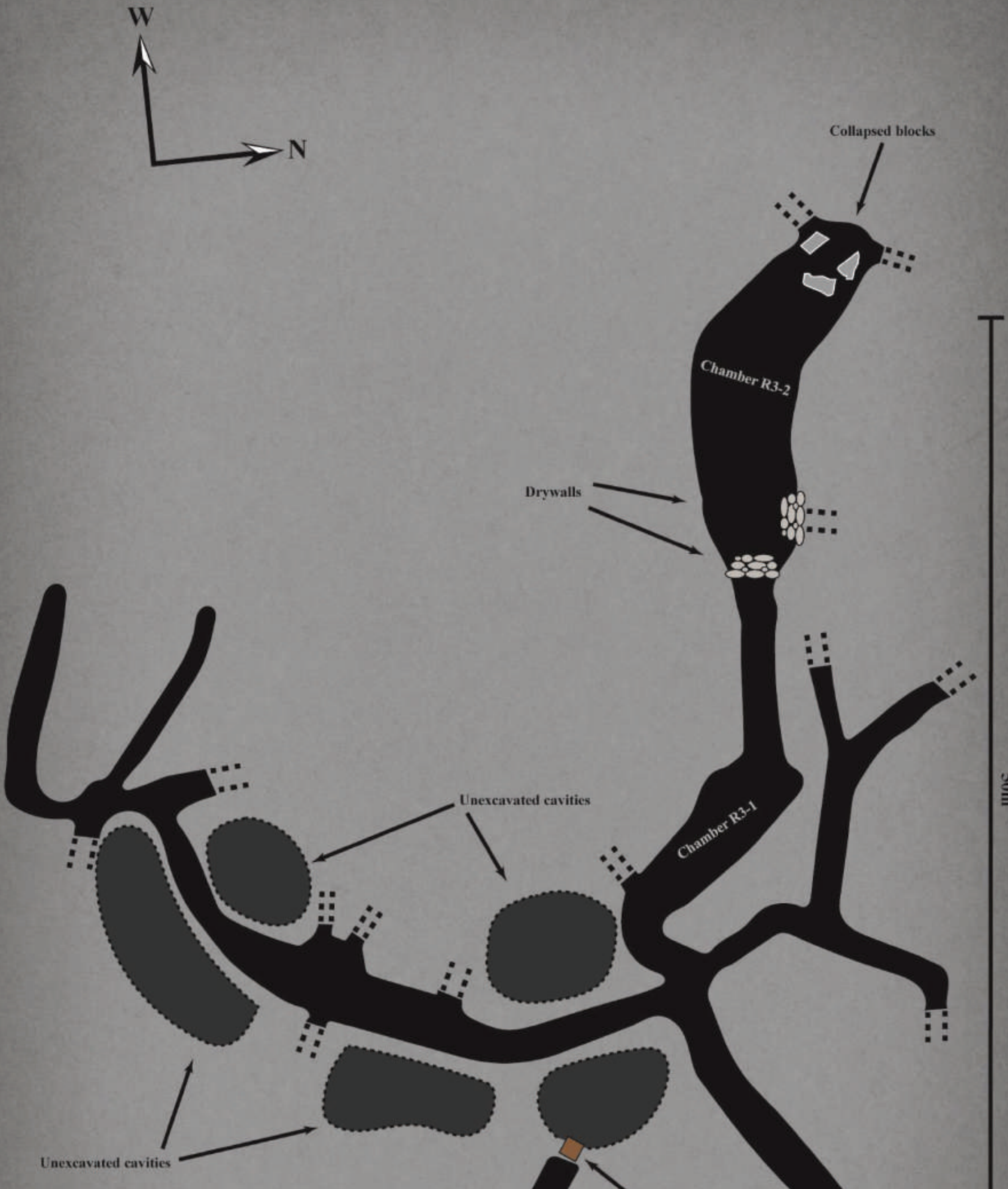
Photo above was taken at the end of the straight passage, looking into the largest known chamber at Ravne3 (R3-2). At the bottom left of the photograph can be seen one of the small cone stalagmites (h.7cm) and above are many 'soda straw' stalactites. The chamber curves towards the left of the photo and measures approx. l.20m x w.4.5m x h.<80cm. Only surface finds have been recovered from this chamber.

This is the first of two westerly heading passages located towards the south of the Ravne3 Tunnels. It is 12m in length and comes to an abrupt end. Why some passages within the Ravne Tunnels Complex lead to nowhere, while others connect with chambers and other passages is still a mystery. Despite its dead end, the passage is still well ventilated and the air quality is high.

In this photo is shown the first of two drywalls discovered within the Ravne3 Tunnels. The drywall is 60cm tall and composed of 5 courses. It was discovered at the end of the straight passage where it meets with chamber R3-2. The wall was excavated from beneath a well-consolidated block of conglomerate upon which the stalagmites were growing. Stratigraphically, this means the drywall is older than the U-Th dated stalagmites above it.

Above is the second drywall to be discovered within Ravne3. It was excavated from loose unconsolidated rubble that had slumped out over it from a blocked up side tunnel behind the wall. The drywall is more substantial than the first, composed of 9-12 courses with dimensions of h. 110cm x w.80cm. The discovery of these two drywalls provided strong evidence that those who created the Ravne Tunnels were also responsible for the creation of Ravne3.

# The Ravne3 Tunnels - 2020




Year of discovery; 2018

Total traversable length of opened tunnels; 170m
Total number of discovered side tunnels; 13
Total number of standing drywalls; 2

The photo above shows the entry chamber to Ravne4 after being excavated (R4-1). It is one of the largest chambers discovered across the entire Ravne Complex, measuring approximately *l*.6m x w.7m. The floor of this chamber has been lowered to assist in access to the adjoining passages. Unlike Ravne3, no artefacts were identified within the raised floor, suggesting Ravne4 had not been reutilized through historic time.

Photo above shows the 23m long northwest heading passage, connecting chambers R4-1 & R4-2. Two side tunnels without drywalls, left and right, can also be identified within this image. Both of these side tunnels are blocked with loose rubble material in the same manor as minor passages across the Ravne Tunnels Complex.

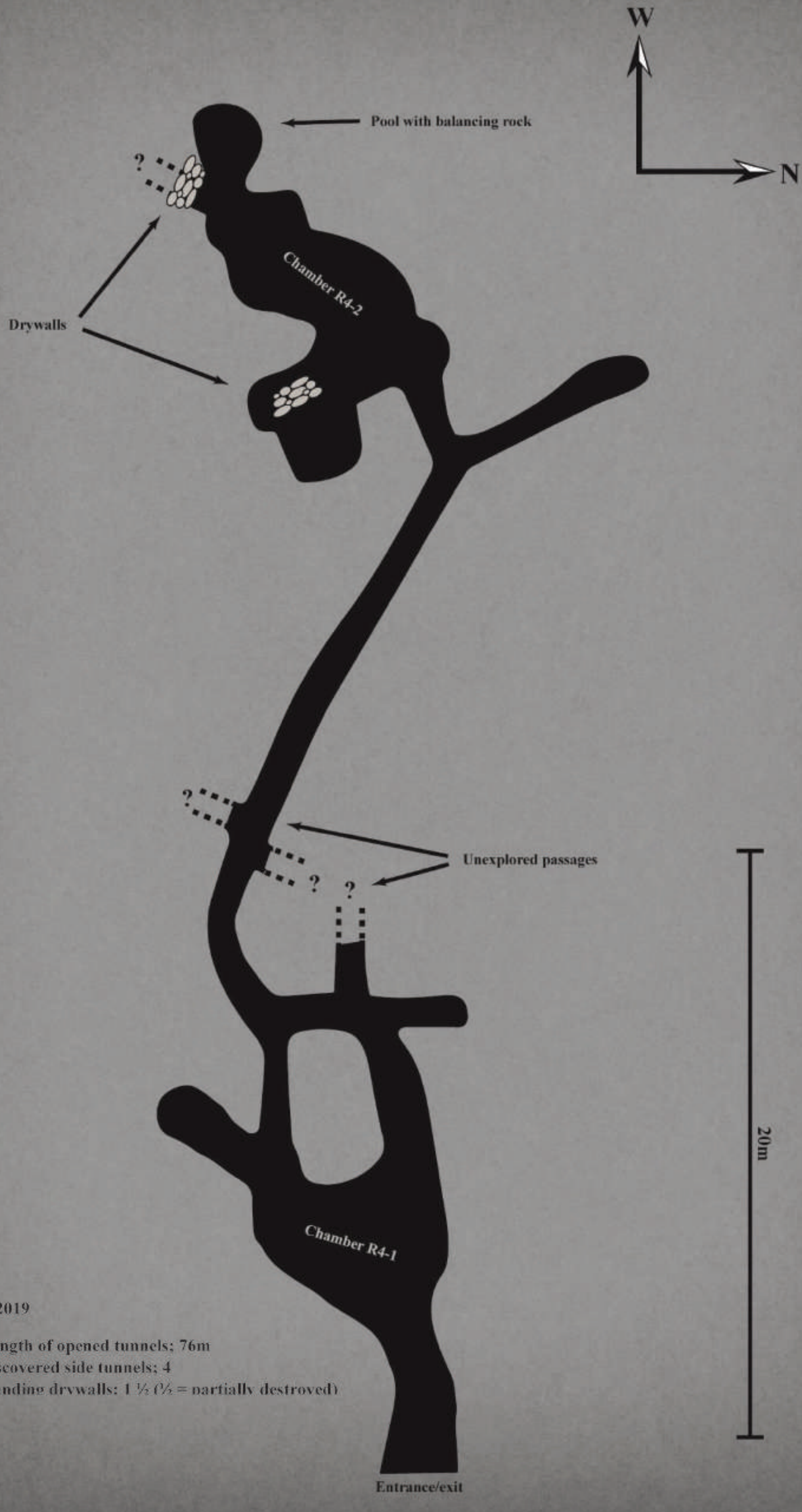
Photo above shows the first and only fully intact drywall so far identified within the explored sections of Ravne4. The presence of drywalls within Ravne, Ravne3 and Ravne4 infers all are part of the same tunnel network, and may have at one time all been physically connected. Within the centre of the drywall is a flat faced slab, one of the small design cues noted previously on some of the drywalls within the Ravne Tunnels.

Beyond the entrance and first chamber of Ravne4, all presently explored sections were found to contain no loose rubble material blocking them, allowing free movement through the passages. The photo above shows the farthest explored section of Ravne4, chamber 'R4-2'. Just as in the Ravne Tunnels and Ravne3, the air is naturally ventilated, of high quality and has high concentrations of beneficial negative oxygen ions.

Small sections of Ravne4 Tunnels have collected groundwater, similar to some of the water sections in the Ravne Tunnels. In the above photo is seen a 7m long northerly heading passage, near to the junction towards chamber R4-2. The passage is approximately 1m wide until it opens up to form a small chamber, when it then comes to an abrupt end.

This is the farthest extent of the Ravne4 Tunnels and the most south-westerly extent of the known Ravne Tunnels Complex. On the left of the photo is a blocked-up passage with large cobbles piled up, suggesting that this was once a drywall that has since collapsed. To the right is a small rounded chamber containing pooling water. Towards the centre of the chamber is a rectangular slab with an egg-shaped stone resting at its centre. It appears to have been placed intentionally.

## The Ravne4 Tunnels - 2020




Year of discovery; 2019

Total traversable length of opened tunnels; 76m
Total number of discovered side tunnels; 4
Total number of standing drywalls: 1 ½ (½ = partially destroyed)

## Ravne Tunnels & the Volunteers

Since 2010, Dr Sam Osmanagich and the Bosnian Pyramid of the Sun Foundation has been running an annual international volunteering program. This initiative allows people from all backgrounds to partake and assist in the ongoing geoarchaeological research taking place within the Bosnian Valley of the Pyramids. No qualifications or prior experience is required and professionals & non-professionals alike are all welcome to join in with the excavations.

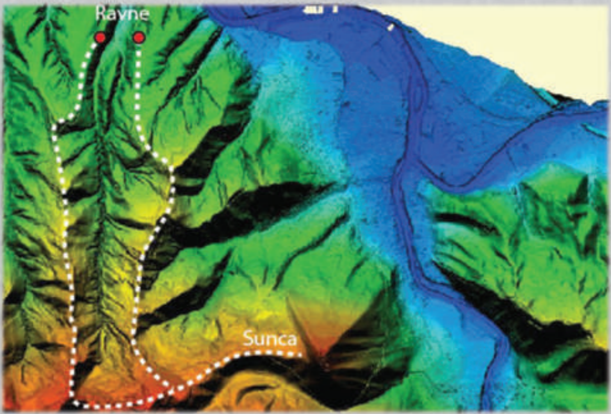
Volunteering is an important aspect for the Bosnian Pyramid project. A large proportion of what is known about the Ravne Tunnels Complex is thanks to the hard work of all the volunteers from previous years, who have made the trip to Visoko and the Bosnian Valley of the Pyramids. Their assistance with the excavations has been invaluable. In 2018, it was in part thanks to a group of volunteers that the discovery of the Ravne3 Tunnels was made. Not only was this the first substantial set of passages identified beyond the original discovery of the Ravne Tunnels, but it also turned out to be one of the most archaeologically significant finds the project has made since excavations began in 2006. Over the course of two years, the excavations at Ravne3 turned up more artefacts in this one location than all the finds discovered by the project across the whole of the pyramid valley. For this reason, and others, we hope that when possible, you may consider also becoming a part of this incredible discovery.

For more information please visit; www.Piramidasunca.ba

## Final Words

Excavations across the Ravne Tunnels Complex have been ongoing since Dr Osmanagic's initial discovery in 2006. The combined length of excavated tunnels including Ravne (1800m), Ravne2 (14m), Ravne3 (170m), Ravne4 (76m), Healing Tunnels (70m) and the Orgon Chamber (10m) equates to 2.14km of traversable underground passages. Over the course of 14 years, this produces an average of just over 150m of tunnels excavated per year. The actual distance of tunnels excavated per year is however less than this figure due to sections of passages being found already without any filling material e.g. Ravne Water Tunnels, Ravne3 chambers, Ravne4 etc.

Measured in a straight line, the Bosnian Pyramid of the Sun presently stands at just over 2.3km southeast from the farthest extent of the Ravne Tunnels. However, it is unlikely, judging by the already explored sections of the Ravne Tunnels and by the topography and geology between the Ravne Tunnels and the Bosnian Pyramid of the Sun, that the underground route to the pyramid will be in a straight line. The distance will in fact be much greater, and so to will be the further effort required to continue this quest towards subterranean access of the Bosnian Pyramid of the Sun.




On the LIDAR image above are two hypothetical routes towards the Bosnian Pyramid of the Sun, one from the Ravne Tunnels and the other from Ravne3-4 on the opposing side of the valley. Following the central peaks (and therefore the deepest possible points at which the tunnels will travel if remaining horizontal), there is a minimum of at least 3.5km further to excavate in order to reach the pyramid. Accordingly, it could take at least a further 23 years at present rates to reach the Bosnian Pyramid of the Sun.

But of course, there is always some light at the end of the tunnel.

The Ravne Tunnels were a mystery in 2006 and today, even after tens of thousands of visitors, volunteers, journalists, researchers and scientists have visited or conducted their scientific investigations, the Ravne Tunnels still remain a mystery. No-one can really know what we will find next. As the Bosnian Pyramid of the Sun Foundation continues to excavate, what we could find tomorrow, next week, next month or even next year, could change all predictions. And so... the digging continues....

# ARCHAEOLOGICAL REPORT RAVNE 3 & RAVNE 4 TUNNELS, VISOKO

**By: Amna Agić, Foundation's Field Archaeologist**

# INTRODUCTION

During the winter of 2020. Archaeological park: Bosnian pyramid of the Sun Foundation did a few archaeological activities. In the beginging of 2020., the Foundation did a geodetic survey of the underground complex of Ravne Tunnels. The team who worked on this project was field geologist Richard Hoyle and field archaeologist Amna Agić. For this project, Tarik Harbaš from agency ''Survey wizards" were hired for geodetic surveys who had 17 years old professional experience on this field.

The aim of this survey was to create an accurate map of every excavated part of the tunnel with precise dimensions, position and orientation of all features inside the tunnel being recorded. Tunnels junctions, chambers, channelized water sections and drywall constructions were all surveyed and included in the maps.

Many passagess inside the Ravne tunnels are still unexcavated . Created map showing the position and the main heading of each unexcavated passage will assist the future work, helping to decide which passages should receive excavation priority. Knowing the geodetic position of each tunnel will also allow the knowing of what topographic and manmade features exist above the tunnels, upon the surface. The production of the map of the complex Ravne Tunnels is also an invaluable resource of understanding principles determining the routes of the tunnels and whether their directions are random. The recorded appearance of the passage can also provide to researchers about motivation and the orginal purpose of the Ravne tunnel.

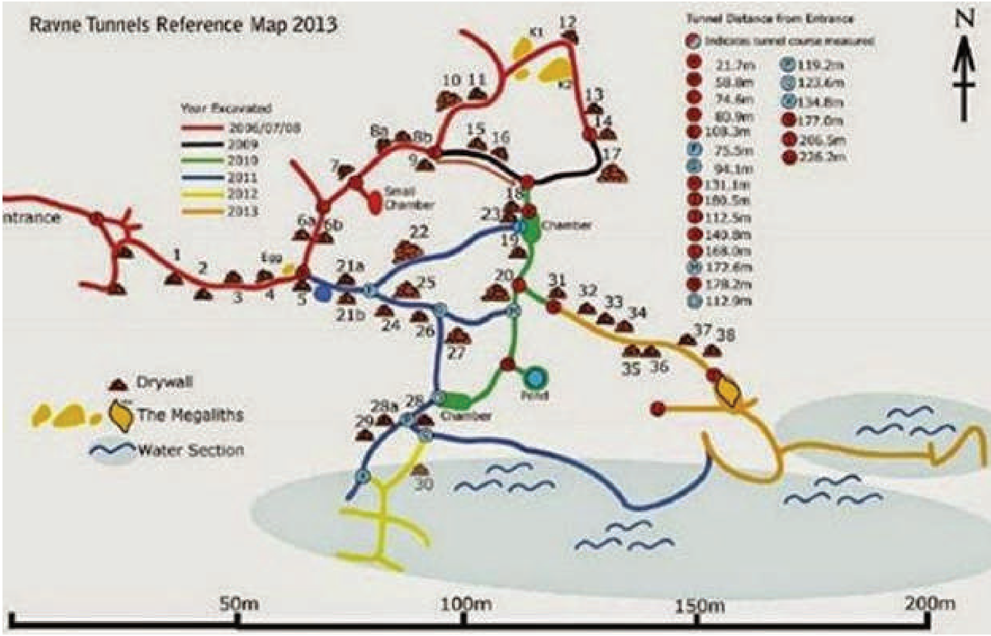



Figure 1: Map of Ravne tunnels from 2013. This was the first attempt to show on the map a comprehensive overview, each drywall and side tunnels along the main passage. The map is based on a map from 2012 but doesn't show the true dimensions of the tunnel.

The survey was principally conducted using the total station in conjuction with retroflector prism. The model Topcon GTS 105N total station was used in this project of maping the tunnels. Three referent points are created by GPS receiver outside of the Ravne Tunnels. Each point provided a datum of known elevation, latitude and longitude at a far greater accuracy than the appropriate standard of measurement for the 1:500 survey scale chosen. These points were used for triangular position of enterance/exit of each tunnel section (Ravne, Ravne 3 & Ravne 4). Reference points for total station were created in the middle of the passages on the strategic locations like main point where three or more passages are meeting each other. We used deepest opened passage in the tunnel. Referent points were created inside the tunnels in a bread-crumb fashion placed at the centreline of the passages at strategic locations such as at a turning point or major junction where three or more passages meet. Referent points were measured using prism all the way of the tunnel walls comfirming passages and drywalls. Change in elevation across all of the tunnels and the height of a cealing in some parts in the tunnels. In sections of the tunnels where it was impractical for the total station to be used safely and effectively, e.g. narrow/low passages & flooded channelized water sections, a manual mapping methodology was adopted. Using a compass for orientation and a laser measuring meter for distance, these manually mapped sections of the tunnels were measured from the nearest pinned station.

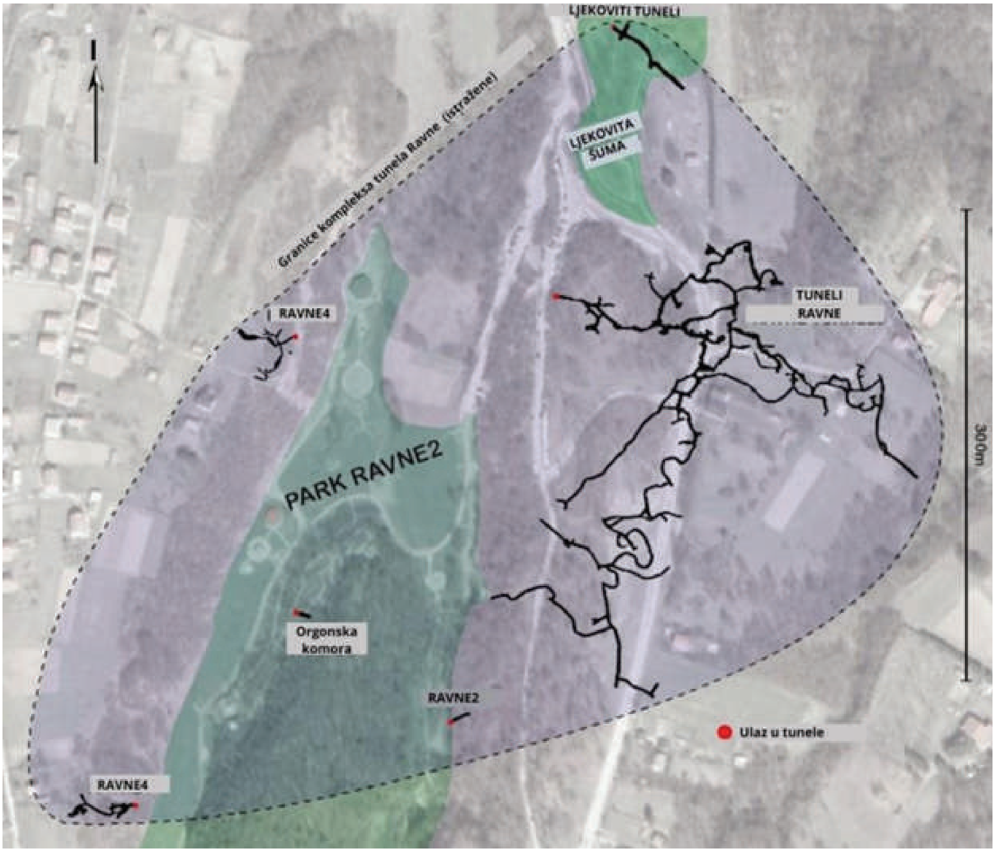



Figure 2: The volume of the Ravne tunnel complex is estimated at about 214,430 m2 with a circumference of slightly more then 1.8 km. (R.Hoyle, 2020)

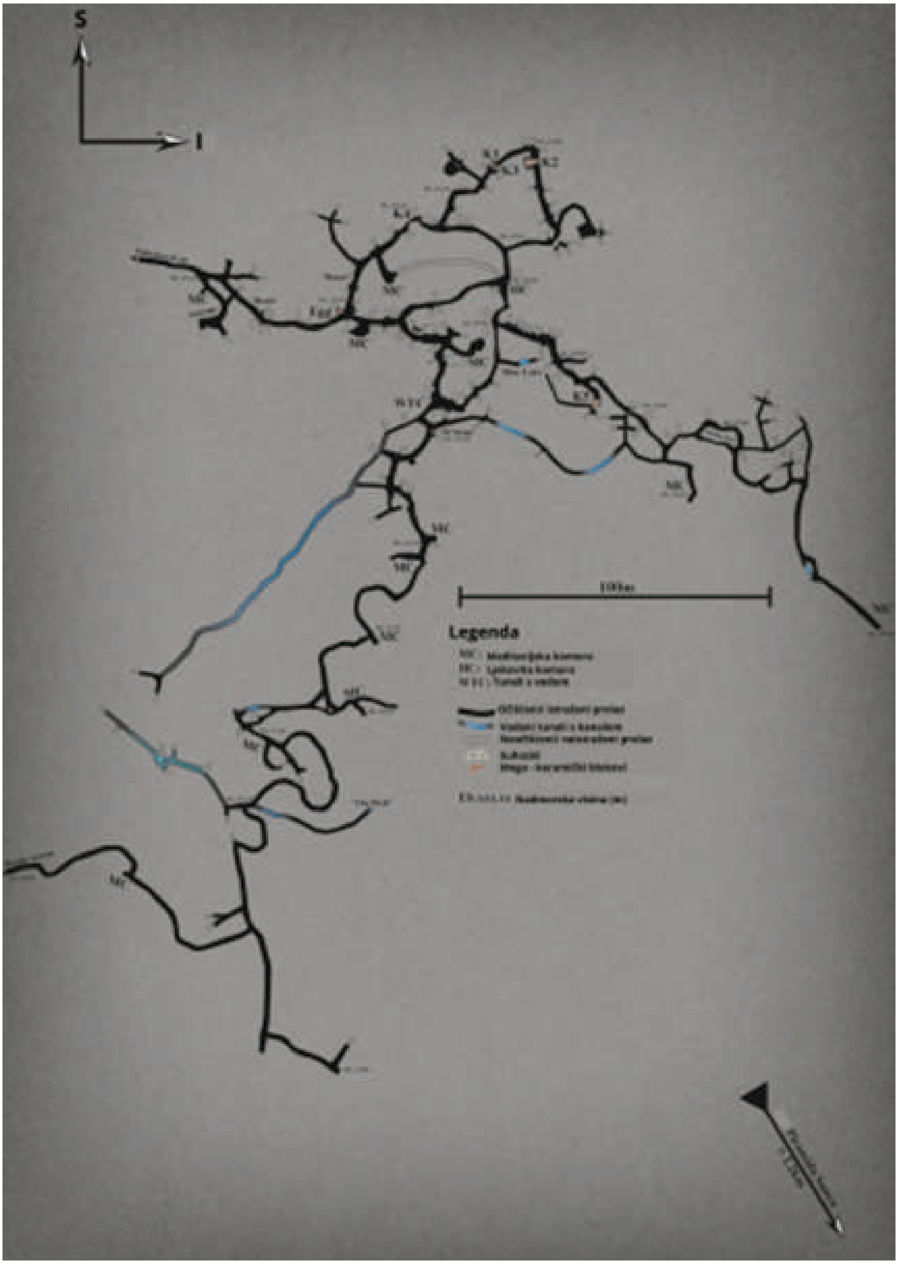



Figure 3: Map of the Ravne tunnels, (R.Hoyle, 2020).

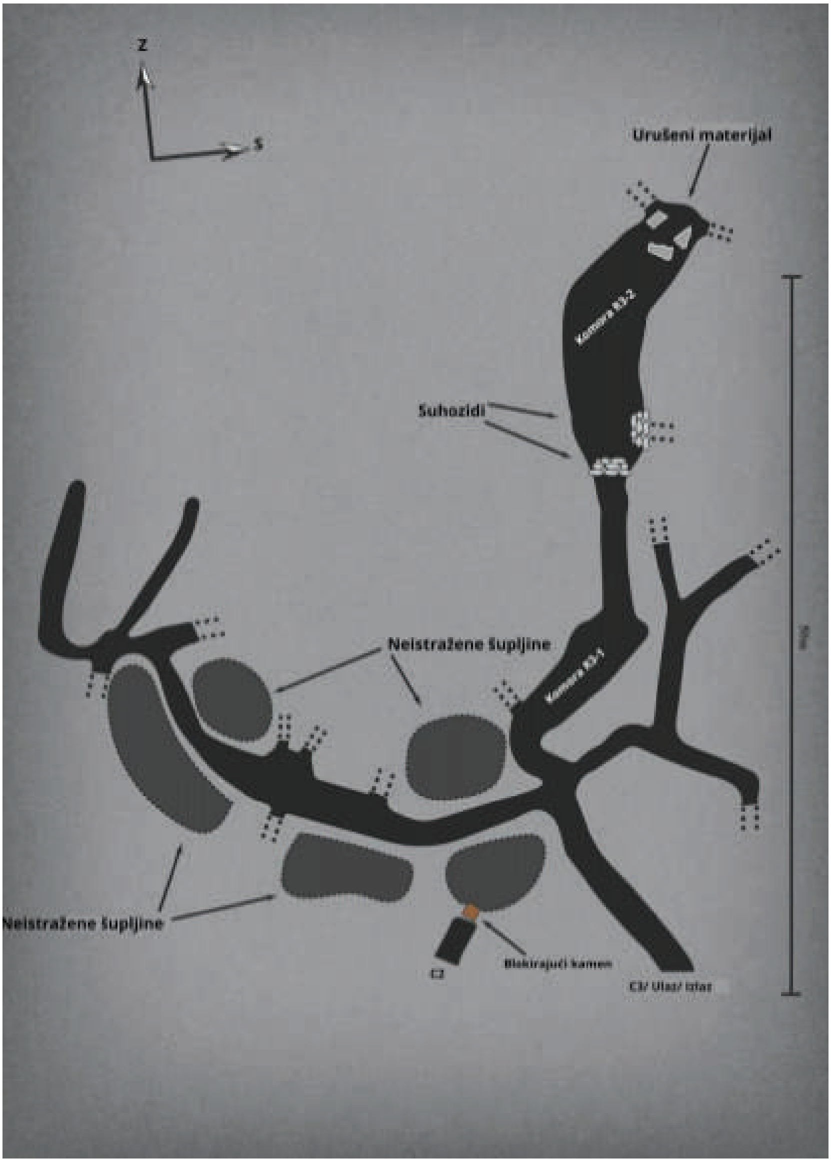



Figure 4: Map of Ravne 3 tunnels, (R.Hoyle, 2020).

Preliminary archaeological exhavation of the Ravne 3 tunnel during the 2019 in section A which was completely free of any blocking material with raised floor (20-60 cm) contained over 1000 artefacts from the diferent archaeological periods, starting with Neolithic, Roman and Medieval period. Artefacts including fragments of ceramic, metal objects, coins. This discovery had the largest number of artefacts found in Ravne tunnel complex.

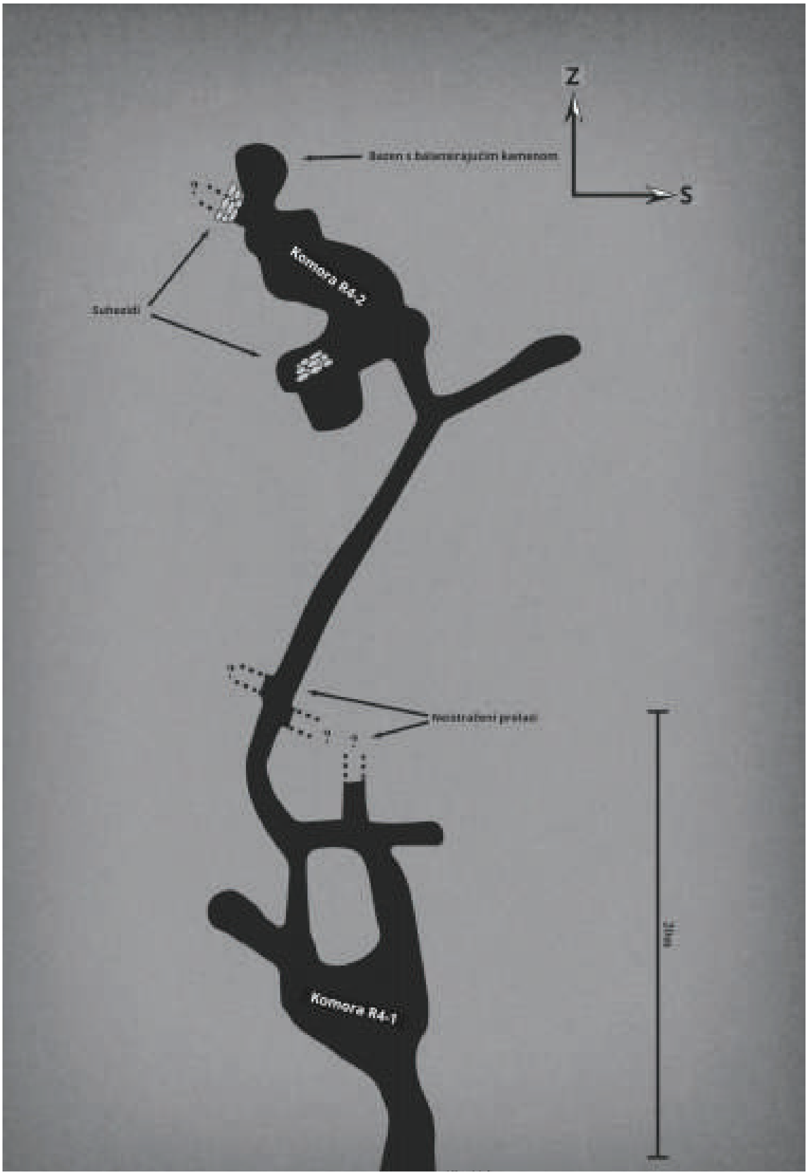



Figure 5: Map of Ravne 4 tunnels, (R.Hoyle, 2020).

## 1. Stalagmite lab analysis

During the preliminary archaeological excavation in 2019, Foundations expert team systematiclly examined the 40 meters of section A inside the Ravne 3 tunnels. Exactly in the middle of the section A, stalagmites were found on the surface of the slab that we assume that collapsed from the ceiling of the tunnel over time. The Foundation team sent three samples of stalagmites for dating to two different laboratories, using two different dating methods.

Stalagmites are sediments that grow upward from the floor of underground spaces. Stalagmites could be different shapes, and formed by dripping water from the ceiling of the stalactites above them. They usually have a rounded top and larger in diameter than the corresponding stalactite above. Unlike stalactites, they don't have a central channel. A drop of water falling from stalactite or from a ceiling contains some carbonate in solution. During a fall through the air and especially when water is hitting the floor, CO2 is released from the droplet and CaCO3 is deposited. The height from the droplet falls, the dripping rate, evaporation, and amount of carbonate in the solution determine the size and shape of the stalagmite. It usually takes several hundred years for the surface to prepare and for the stalagmite to begin to form. More massive stalagmites are formed during rapid dripping when deposition takes place on the sides of the stalagmite which then growns in width. With slower dripping most of the sediment remains on top of the stalagmite which becomes high and thin. The carbonate layers are perpendicular to the growth direction of the stalagmites. Depending on the change in the composition of solution from where they are formed, and on the flood sediments that can occasionally cover them the layers can be different composition and color. The age of the stalagmites can be determined relatively and absolutely. Relative age is determined by comparing the order of growth from where we find out which stalagmites or their layers are older and which are younger. Absolute age is expressed in years and it is the most often determined by measuring the unstable (radioactive) isotope carbone C14 and the ratio of the isotopes Uranium 234U and Thorium 230Th. Removing part of the slab in section A in Ravne 3 tunnels where we already found stalagmites we discovered first drywall S1 in the Ravne 3 tunnels. Drywall S1 were under layer of stalagmites we analysed earlier in two different European labaratoryes. First analyse of the stalagmite S001 from Kiev (Ukraine) with radiocarbon method gave us result of 26.200 +/- 200 years old. Radiocarbon or c14 method is method for apsolut determination of oldness. Carbon (C) has three main isotopes: stable C12 and C13, and radioactive C14. The concentration of C14 in the atmosphere is relatively constant as well as in living beings that take in carbon into the body (the so-called carbon cycle- plants take carbon from the air, plants eat plants. Carnivores feed on herbivores). With the death of the organism, the unification of carbon stops, the amount of radioactive C14 gradually decreases. Since the rate of decomposition is known, the amount of C14 is measurable, ti is possible to determine the time that is protective agains the current death of the organism. The method gives the best results in determining the age from 1.000 to 50.000 with a certainty of up to 70-000 years or younger samples from 1.000 years.

Figure 6: The first drywall S1 discovered in the Ravne 3 tunnels (photo: R. Hoyle, 2019)

## 1.1 Uranium thorium analysis methods

Radiometric dating is process of determining the age of rocks based on the radioactive decay of individual elements. It has been in wide use for more than half a century. To date over 40 different procedures have been perfected where each uses a different radioactive element or a different method of measuring its content. This method is also known in archaeology as the Uranium series. Based on this method the age is determined, based on the process of radioactive decay of Uranium which contains radioactive isotopes of Uranium U238 and

U235 and Thorium Th232 which decay into a series of isotopes. A large number of members of this series are isotopes with a short half-life but for some half-lives they are sufficient to be significant for dating: in the U238 series they are isotopes of ion U234 (245,000 years) and Thorium Th230 (75,400 years) and in the U235 isotope of protactium Pa231 (32,500 years). Method can be applied to a variety of materials. Uranium- thorium radiometric method is based on the determination of Thorium and Uranium contents. Simultaneously with the growth of stalagmites, and deposition of calcite complex Uranium carbonates are excreted in very small quantities. Radioactive Uranium will continue to decompose into Thorium and the older deposits with more Thorium and less Uranium. The limit for determining the age of deposits by this method is 350,000 to 400,000 years with an error of up to 5%. The average age of sediment growth can be determined based on their age taking into account more or less growth interruptions.

Figure 7: Example of stalagmite S002, Ravne 3 tunnels,
Visoko (photo: R. Hoyle)

The second analysis of stalagmite S002 by the Uranium- thorium method gave us an age of 5,900 +/- 200 years. So different methods, on several different stalagmite samples gave us different results. The reason for this is probably different sample everytime we send to the lab. During the removing the surface layer of stalagmite at the depth of 20 cm below the surface we descovered another layer of stalagmites. Stalagmites which were found below the surface are older than those found on the surface. Laboratory analysis of the US001 stalagmite which was located in the lower layer of the slab, done at the Institute of Geology at the Czech Academy of Science, gave us age of 19,000 +/- 1,000 years. Sample stalagmite S008 dated by the same method gave us an age of 15,000 +/- 1,000 years. Uranium and Thorium were separated from the carbon matrix using a chromographic method with TRU chemical resin. The procedure was performed in the laboratory of the Institute of Geological Sciences of the Polish Academy of Sciences (Warsaw, Poland). Internal standard samples were prepared at the same time to study the samples. The isotopic composition of Uranium and Thorium measurements was performed at the Institute of Geology of the Czech Academy of Sciences (Prague, Czech Republic). Attached is the result of laboratory analysis of Uranium-thorium by the dating method.

## U-series dating report

Institute of Geology CAS

Samples quantity: 2

Material: calcite powder

**Method description:**

***Chemical procedure of uranium and thorium separation***

After thermal decomposition of organic matter a $^{233}U$-$^{236}U$-$^{229}Th$ spike is added to samples before any further chemical treatment. Sample is dissolved in nitric acid. Uranium and thorium is separated from carbonate matrix using chromatographic method with TRU-resin. Chemical procedure has been done in U-series Laboratory of Institute of Geological Sciences, Polish Academy of Sciences (Warsaw, Poland). Internal standard sample and blank sample were prepared simultaneously any series of studied samples.

***Measurement***

Isotopic composition of U and Th measurement has been performed in Institute of Geology of the CAS, v. v. i. (Prague, Czech Republic). Measurements were performed with a double-focusing sector-field ICP mass analyzer (Element 2, Thermo Finnigan MAT). The instrument was operated at a low mass resolution ($m/\Delta m \geq 300$). Measurement results were corrected for counting background and chemical blank.

**Results:**

| Lab. no. | Sample | U cont. [ppm] | $^{234}U/^{238}U$ AR | $^{230}Th/^{234}U$ AR | $^{230}Th/^{232}Th$ AR | Age [ka] | *Corrected age [ka] | **Initial $^{234}U/^{238}U$ AR |
|---|---|---|---|---|---|---|---|---|
| 1518 | US 001 | 0.0277±0.0001 | 1.2743±0.0053 | 0.2581±0.0053 | 1.823±0.037 | 32.38±0.76 | 19±1 | 1.289±0.068 |
| 1519 | S008 (a) | 0.0458±0.0002 | 1.2354±0.0049 | 0.2308±0.0050 | 1.696±0.037 | 28.54±0.71 | 18±1 | 1.241±0.083 |

Calculations use the decay constant of Jaffey et al., 1971 ($^{238}U$), Cheng et al., 2013 ($^{234}U$ and $^{230}Th$) and Holden, 1990 ($^{232}Th$). Ages do not include uncertainties associated with decay constants.

AR – activity ratio.

* Corrected ages using typical silicate activity ratio $^{230}Th/^{232}Th$ = 0.83 ± 0.42 derived from the $^{232}Th/^{238}U$ activity ratio = 1.21 ± 0.6, $^{230}Th/^{238}U$ activity ratio = 1.0 ± 0.1, and $^{234}U/^{238}U$ activity ratio = 1.0 ± 0.1 (e.g., Cruz et al., 2005).

** Calculated based on $^{234}U/^{238}U$ AR corrected for detrital contamination and corrected age.


Cheng H, Edwards RL, Shen C-C, Polyak VJ, Asmerom Y, Woodhead J, Hellstrom J, Wang Y, Kong X, Spötl C, Wang X, Alexander EC. 2013. Improvements in 230Th dating, 230Th and 234U half-live values, and U-Th isotopic measurements by multi-collector inductively coupled plasma mass spectrometry. Earth and Planetary Science Letters 371-372: 82-91.

Cruz Jr., F., W., Burns, S.J., Karmann, I., Sharp, W.D., Vuille, M., Cardoso, A.O., Ferrari, J.A., Dias, P.L.S., Viana Jr., O., 2005. Insolation-driven changes in atmospheric circulation over the past 116,000 years in subtropical Brazil. Nature 434, 63–65.

Holden, N.E., 1990. Total half-lives for selected nuclides. Pure and Applied Chemistry, 62: 941–958.

Jaffey, A.H., Flynn, K.F., Glendenin, L.E., Bentley, W.C., Essling, A.M., 1971. Precision measurement of half-lives and specific activities of U-235 and U-238. Physical Review C 4: 1889-1906.


Figure 8: Report of Uranium- thorium analysis of stalagmites US001 and S008 (Institute of Geology, Czech Academy of the Sciences, Prague)

According on the large number of stalagmites found in the Ravne 3 tunnels which still remain in situ in section A and in section A2, future laboratory analyses are necessary to understand the chronology of anthropogenic activity and to understand chronological sequence within the Ravne 3 tunnels as well. The age of the stalagmites can be associated with several archaeological cultures that existed in the area of Visoko as well as in other areas in Bosnia and Herzegovina. At the time when in southeast Europe there is a full development of domestication of animals and cultivation of celiacs and when agriculture and animal husbandry become the main economic pillars of human society, there is the formation of several cultural groups in Bosnia and Herzegovina. These phenomena, accompanied by the introduction of new types of flint and stone tools, the first ceramic products, the construction of permanent settlements and new and more complexed social organization, experienced their full manifestation in this area and contributed to Bosnia and Herzegovina remaining active on the storage of major cultural and historical events. The currents of cultural and historical development in the Visoko region begin in that long younger Stone Age during the 5th and 4th millennium BC. The Neolithic man of the Visoko region followed the basic directions of the historical development of human society but at the same time influenced the formation of a special cultural and artistic expression, combining the universal demands of the universal evolution of human society and culture with his own understanding of nature and the world lived. This last statement does not refere exclusively to the bearers of culture of the Visoko region but also to the bearers of culture in the wider area of central Bosnia where is a very specific Neolithic world known as Kakanj and Butmir culture is formed and shaped. The oldest Neolithic site in the Visoko area is the one in Arnautovići and belongs to the so-called Kakanj culture named after its first explored site in Kakanj. Kakanj culture is the oldest orginal cultural creation formed in this part of Bosnia but not the oldest Neolithic culture in general. Todays knowledge of the course of this development allows us to say with certainty that central Bosnia largely missed the intial stages of the older Neolithic and that the cultural manifestation of that time realized in the central Balkans on the one side, and the coastal belt on the other of their exisence the penetrate this area as well. These are two genetically completely different but simultaneous cultural phenomena, Starčevo and Impresso culture, the first of which mainly develops on the territory of Serbia and the second along the eastern Adriatic coast and its immediate hinterland. At one point in their development, towards the end of the older Neolithic bearers of Impresso and Starčevo culture reached the valley of the river Bosna, achieved a common life but at the same time retained the most distinctive features of their material culture. In terms of archaeology the oldest archaeological site in Bosnia and

Herzegovina is the national monument of Badanj cave near Stolac. Research has established that this site is from Late Paleolithic period, 13,000 to 12,000 years BC. A partivulary significant discovery at this site a drawing engraved in a rock representing a horse attacked by arrows which is characteristic of the region of Mediterranean art of Paleolithic man. It is quite certain that the result of the dating of the stalagmites surpassed the dated archeological cultures and locations.

Figure 9: Position of stalagmites and stalactites inside the Ravne 3 tunnel (photo: R. Hoyle)

During October 2020, the expert team of the Foundation started cleaning section A2 inside the Ravne 3 tunnels in order to facilitate accessibility and to prepare for the upcoming excavation. On that occasion, another drywall was discovered. Position where the drywall no.2 was found two meters away from the second drywall found during the 2019 survey. This drywall is unique in relation to all identified drywalls within the Ravne tunnel complex. Namely the large stone is located in the middle of the two end parts of the drywalls which are made in a typical way. The total length of this construction is 260 cm, making this draywall as one of the longest drywall of the Ravne tunnel complex. In addition to the small animal nest behind the left side of the drywall that laterally intersects the passage over the entire structure, the passage is completely buried.

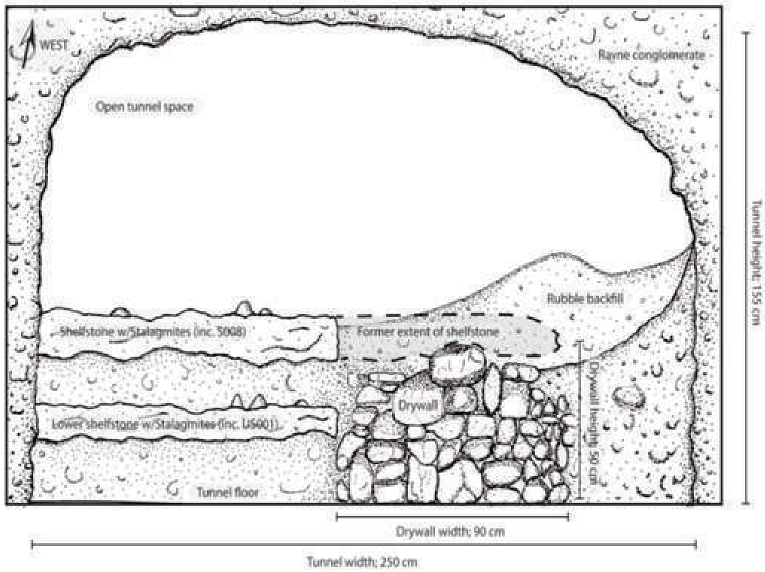



Figure 10: The first drywall (drywall 1) discovered in the Ravne 3 tunnels during 2019 (drawing made by R. Hoyle, 2020)

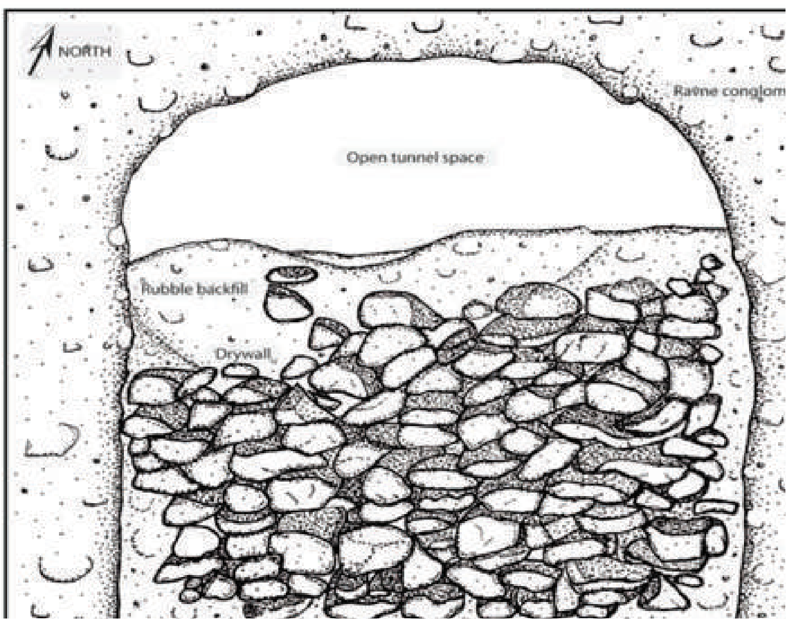



Figure 11: The second drywall (drywall 2) discovered in Ravne 3 tunnels during 2019 (drawing made by R. Hoyle, 2020)

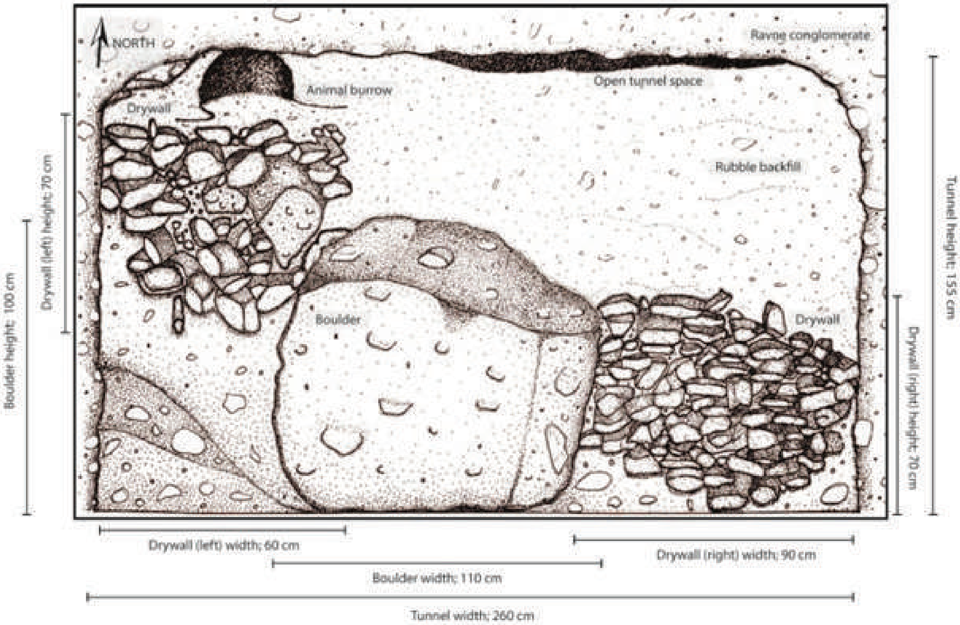



Figure 12: Drywall (drywall 3) discovered in the Ravne 3 tunnels (drawing made by R. Hoyle, 2020)

## 2. Ravne 4 tunnels

At the end of 2019, we discovered new entrances to the tunnels, the Ravne 4 tunnels. During the regular works on the infrastructure in the Ravne 2 Archaeological and Touristic park, the Foundation workers discovered one small conglomerate cavity, which showed us the potential for discovering the entrance to the tunnel. During the cleaning of the cavity a 63 meter long tunnel with side passages and visible drywalls on the sides were discovered. These tunnels which are located on the same side as the Ravne 3 tunnels, at the same altitude and in the direction of extension to the south, we named these tunnels as Ravne 4 tunnels. These tunnels are part of the same tunnel network. During 2020, the Foundation carried out preliminary works inside the tunnel for the purpose of protection, safety at work and preparation site for upcoming archaeological excavation. A canopy and the acess road to the tunnels were built, an entrance door was set up for the purpose of protecting the potential archaeological site, the tunnels were supported by supported and protective pillars and electricity was brougt into the tunnels. In the future the Foundation plans to conduct archaeological research starting in 2021.

Figure 13: Ravne 4 tunnels during the discovery in 2019 (photo: A. Agić)

Figure 14: Entrence to the Ravne 4 tunnels, 2019 (photo: A. Agić)

Figure 14: Preparation and protection the enterance of Ravne 4 tunnels, 2019
(photo: A. Agić)

Figure 15: Preparation for the upcoming archaeological work in Ravne 4 tunnels, 2019 (photo: A. Agić)

Figure 16: Interior of Ravne 4 tunnels (photo: A. Agić)

Figure 16: Interior of Ravne 4 tunnels (photo: R. Hoyle)

## CONCLUSION

Discovery of the drywalls in Ravne 3 tunnels is important for entire Ravne tunnel complex. Drywall from the Ravne 3 tunnel corresponds to those located in other locations within the Ravne complex in terms of its shape, method of construction, function its complexity and the type of stone used during construction. Archaeological material found in the Ravne 3 tunnels during 2019, suggests that it is a small part within the Ravne tunnel complex that was opened and reused over different periods of time, and closed afterwards again. Laboratory analysis with the Uranium- Thorium method which gave us the results of 19,000 years old is of great importance for the entire project, the city of Visoko and then for the entire history of Bosnia and Herzegovina.

Future excavation, laboratory analysis and further research will bring us clearer knowledge about anthropogenic activity within the Ravne 3 tunnels, but also Ravne 4 tunnels as well.

## REFERENCE

AGIĆ 2019.: Amna Agić, Izvještaj o arheološkim istraživanjima u tunelima Ravne 3, Visoko, Fondacija ''Arheološki park: Bosanska piramida Sunca"

ANĐELIĆ, BOJANOVSKI, ČOVIĆ, MARIJANOVIĆ 1984.: Pavao Anđelić, Ivo Bojanovski, Borivoj Čović, Brunislav Marijanović, Visoko i okolina kroz historiju I, Prethistorija, antika i srednji vijek, Skupština opštine Visoko, Visoko

HOYLE 2020.: Richard Hoyle, Geochronology of Ravne 3 Speleothems: Samples; S008 & US001, BPS Foundation

HOYLE 2020.: Richard Hoyle, Subterranean Survey 2020 Ravne Tunnels Complex, BPS Foundation

HOYLE 2020.: Richard Hoyle, The Ravne Tunnels Complex, The Excavated Drystone Walls of Ravne 3 Tunnels, BPS Foundation

SREJOVIĆ 1997.: Dragoslav Srejović, Arheološki leksikon- preistorija Evrope, Afrike i Bliskog istoka, grčka, etrurska i rimska civilizacija, Savremena administracija, Beograd

## ‘RAVNE 3’ TUNNELS - PHOTOS BY HARIS DELIBAŠIĆ

The senior guide of the Foundation ‘Archaeological Park: Bosnian Pyramid of the Sun’ and still
a great lover and enthusiast of the Bosnian pyramids project, Haris Delibašić has worked with this project since the beginning, spreading his knowledge and good energy to numerous guests
who came to the pyramids and tunnels.

In recent years, he has specialized in photography, paying special attention to details, light and atmosphere.

This time, we are attaching a photo gallery that he made in different sections of the
prehistoric underground tunnels ‘Ravne 3’ in Visoko

# FOREWORD

Archaeological park: Bosnian pyramid of the Sun Foundation has run a major multidisciplinary project for almost 15 years now. We made the discovery of the Ravne 3 tunnels in July of 2018. With the acquisition of a permit for archaeological research by the Ministry of Culture, Education, Science and Sports of the Zenica-Doboj Canton in 20019, work in cooperation with the Local Museum began.

Archaeological park: Bosnian pyramid of the Sun Foundation in September 2019 will organize and present to the public artifacts of the Ravne 3 Tunnels. Visoko is a city with great history that goes far back in time. This area was one of the most important in the medieval state of Bosnia, and therefore most of the items on display at the exhibition of Ravne 3 Tunnels are from that time period. However, some of the most interesting finds are much, much older.

Archaeological park: Bosnian pyramid of the Sun Foundation

**EXHIBITION**

# Artifacts of the Ravne 3 Tunnels

Curator of the exhibition: Amna Agić
Co-curators of the exhibition:
Richard Hoyle &Marie-Sophie Gristi

September 22, 2019.

The artifacts of Ravne 3 Tunnels being presented at the exhibit are archeological materials found from February to September 2019. The Ravne 3 Tunnels are important because once initial entry into the tunnel network was gained we identified a section in the tunnels that was open and easily acessible. Initially in February when surface finds were being collected from this section we found over 80 partially buried fragments of pottery.

From these initial artefacts we realized we had found two different vessels. During the above mentioned time period we found many different artifacts, from various time periods. We also were able to collect significant amounts of organic material in the form of carbonized wood, all of which showed to us continuous human activity within the Ravne 3 tunnels.

In August 2018, volunteers at the very enterance to the tunnels found a Roman Hedge Bill. Soon after we found fragments of pottery ranging from the Roman period until the Middle Ages. The number of fragments found is 3132 pieces, large and small in size, which are part of several different vessels. The fragments of Terra sigillata ceramics are a very special find for us, as we know that Terra sigillata is a luxurious Roman pottery that was used only for special occasions. The exhibited artifacts of the Ravne 3 tunnels are representative

fragments of vessels, several metallic objects, including a piece of jewelry, most likely a pendant necklace with floral or animal depictions. Finally, preseneted at the exhibition will be a newly created 3D topographic model of the Bosnian valley of the Pyramids. The geological context of the Ravne 3 tunnels will also be given.

Hedge bill belongs to the family of tools as well as sickles (falces). Hedge bill were used to cut reeds and shrubs. It was also used for cutting vines, harvesting fruits and cutting branches. The tool is 28,5cm long, corroded, with wood residue in the handle. Based on analogies with similar findings found in Bosnia and Herzegovina, it dates to Roman times.

Terra sigillata is a luxory Roman pottery. The intensity of this production depended on the presence of ilite clay, and therefore this technique was most prevalent in areas rich in this material, which gives the ceramics a distict red color and a smooth surface. In addition to the aesthetics, these dishes were also pratical as it was certainly easier to maintain ceramics with smooth surfaces. However, all of its advantages as well as the long process of making it, led to the fact that only the richest citizens could afford it.

Metal artifacts/objects are an important part of our discoveries. In July 2019 we found numerous metal artifacts some of which are reminiscent of coins. We cannot see any ornamentation upon them because of the high level of corrosion, but their dimension, shape, and material reminds us of minted coins. We found 21 pieces.

We also found medieval hand-made nails, one knife and one buckle. Because of corrosion as with the 'coins', we cannot date the buckle nor recognize the type of buckle.

A buckle is an object which has the purpose to connect the clothes, like a ancient broach. Buckles are not only decorative piece of jewelry they also had a functional purpose as well. Mostly they are made from four(4) basic pieces, body, needle, spring, buckle, and some simple examples have two pieces. Because of its form we assume this buckle is from the Roman period.

A piece of jewelry– a pendant that was found in July 2019, there are also indications that the item found is a part of horse equipment. Based on the ornament, we conclude that the object is more decorative than functional and that it is a Romanized Celtic object/period.

Fragments of medieval ceramics dominate among the finds in terms of volume. These are mostly fragments made from low quality material, dirty clays with plenty of sand. Pots may be thinner or thicker walled, ornamented or not. Based on the findings it can be concluded that these vessels had different purposes. The color ranges from dark brown, to dark and light grey that maches the natural clay color. Several fragments with a horizontal line stand out as a decoration.

# GEOCHRONOLOGY OF RAVNE 3

In August 2018 speleothem sample 'Stalagmite S001' was extracted from the Ravne 3 Tunnels for Carbon 14 isotope analysis in order to determine the minimum age of the cavities present at Ravne 3.

Stalagmites are formed by the slow accumulation of dissolved calcium carbonate (CaCO3), which precipitates out of the groundwater as it drips down from the ceiling of a cavity onto the floor. Some of the carbon atoms forming the carbonate are the radioactive C14 variety. By finding the ratio between the stable and radioactive carbon isotopes it is possible to determine the age of the carbonate forming the stalagmite. Since stalagmites can only form within a cavity with an oxygenated atmosphere, by ascertaining the age of the stalagmite we can determine the minimum age of the tunnels at Ravne3.

Analysis of the stalagmite at the Kiev Radiocarbon Laboratory in Ukraine produced a date of 26,200 years +/- 200. This result correlates with other C14 dates given by other materials analysed from around the Bosnian Valley of the Pyramids

# VOLUNTEERS AT RAVNE 3

All work undertaken at the Ravne 3 site has been conducted with the assistance of volunteers from around the world. Under direct supervision of the Foundations trained field staff, the initial discovery of the Ravne 3 Tunnels was made by volunteers, entry into the tunnels was made by volunteers and the archaeological excavations producing the finds of this exhibition were also conducted by volunteers. This is what makes the Bosnian Pyramid archaeological project so special and unique in the world. Not only has Dr Sam Osmanagic shown to the world our given history is wrong, he has also given people the opportunity to participate in correcting it!

Volunteers in summer 2018 gaining entry into the Ravne3 Tunnels.

# CLOSING WORDS

In 2006 Dr Sam Osmanagich announced to the world his discovery of the nearby Ravne Tunnels. Outspoken critics to his pyramid hypothesis immediately dismissed the archaeological significance of the Ravne Tunnel complex. 'Authoritative' figures attacked Dr Sam by making baseless claims the passages were the work of the former Yugoslavian Army or even more preposterous that Dr Sam was digging the tunnels himself!

The Ravne 3 Tunnels are a landmark discovery for the Bosnian Pyramid of the Sun Foundation. The shear number of artefacts uncovered from different archaeological periods prove without doubt that the Ravne 3 tunnels do have archaeological significance and have been known and used by previous cultures through time.

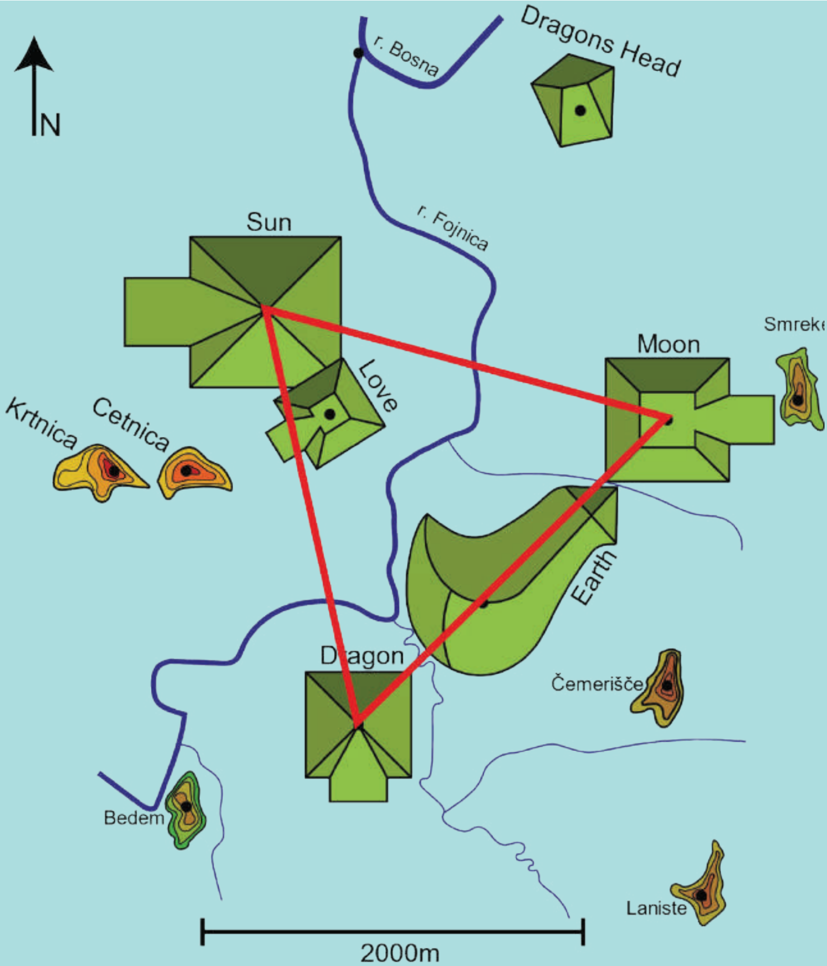
The existence of the Ravne 3 Tunnels support Dr Sam's original hypothesis he made in 2006 and the same critics who initially condemned and mocked him are now suspiciously quiet regarding this latest discovery. This is an important step forward for the Bosnian Pyramid of the Sun Foundation, for the history of Visoko, Bosnia & Herzegovina, and eventually, the world.

Richard Hoyle Foundation Field Geologist

# ROMAN TEGULA

On the cover of the catalogue is a Roman tegula (roman roof tile) found in the Ravne 3 tunnels. In our example it appears as a single loop in the form of a braid. This type of decoration is always along the underside of the tegula so that it is preserved while being placed on the roof.


| | |
|---|---|
| Organizers of exhibition; | Bosnian Pyramid of the Sun Foundation |
| Curator of the Exhibition; | Amna Agić |
| Co-curators of the exhibition; | Richard Hoyle, Marie-Sophie Gristi, Evelina Čehajić, Emina Smajić, Amna Agić |
| Foreword; Closing words; Editor; Promoter; | Richard Hoyle |
| Technical; Publisher; | Muhamed Dževlan |
| For publisher; | Dr Sam Osmanagich |
| | Mustafa Bajić |
| | CPU Print company Sarajevo |
| | AP Bosnian pyramid of the Sun Foundation |




# THE PLANER ALIGNMENTS
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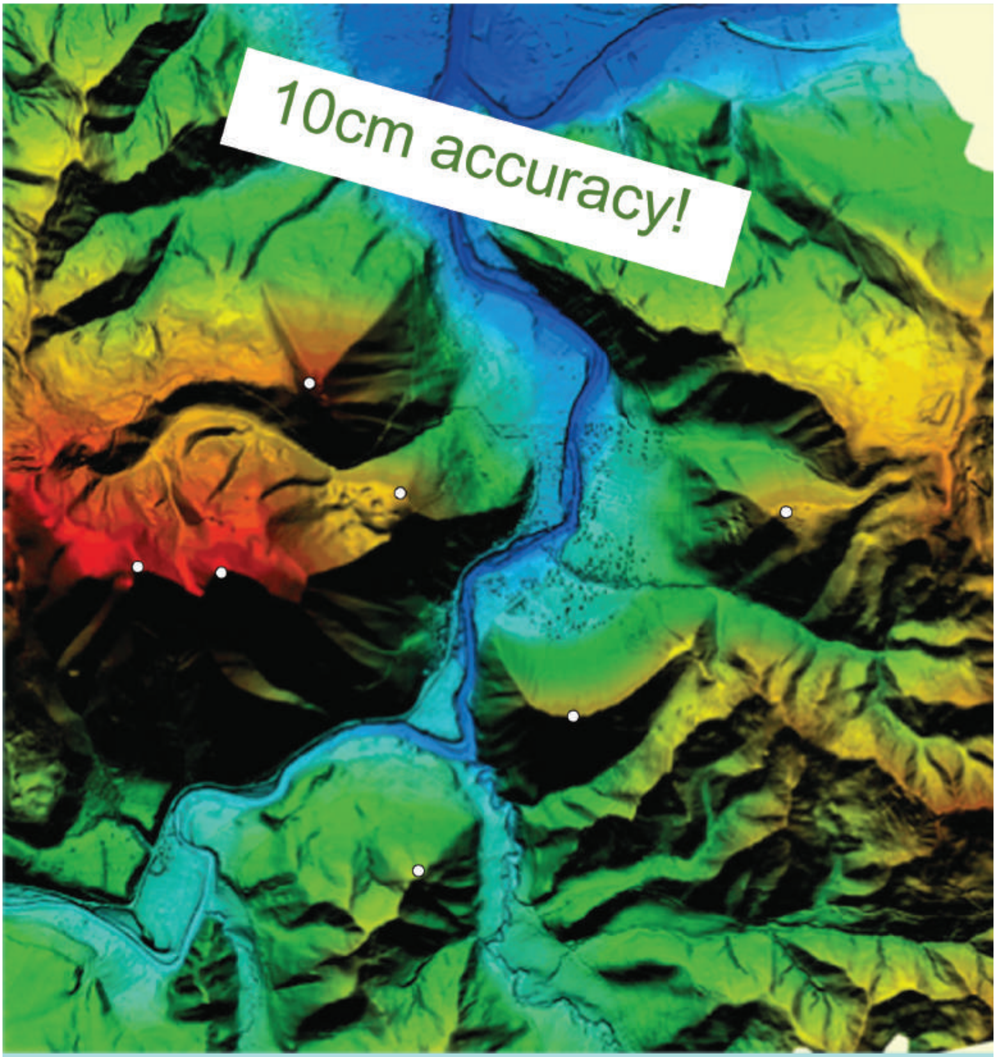
# SACRED GEOMETRY

# OF
# THE

# BOSNIAN PYRAMID
# VALLEY

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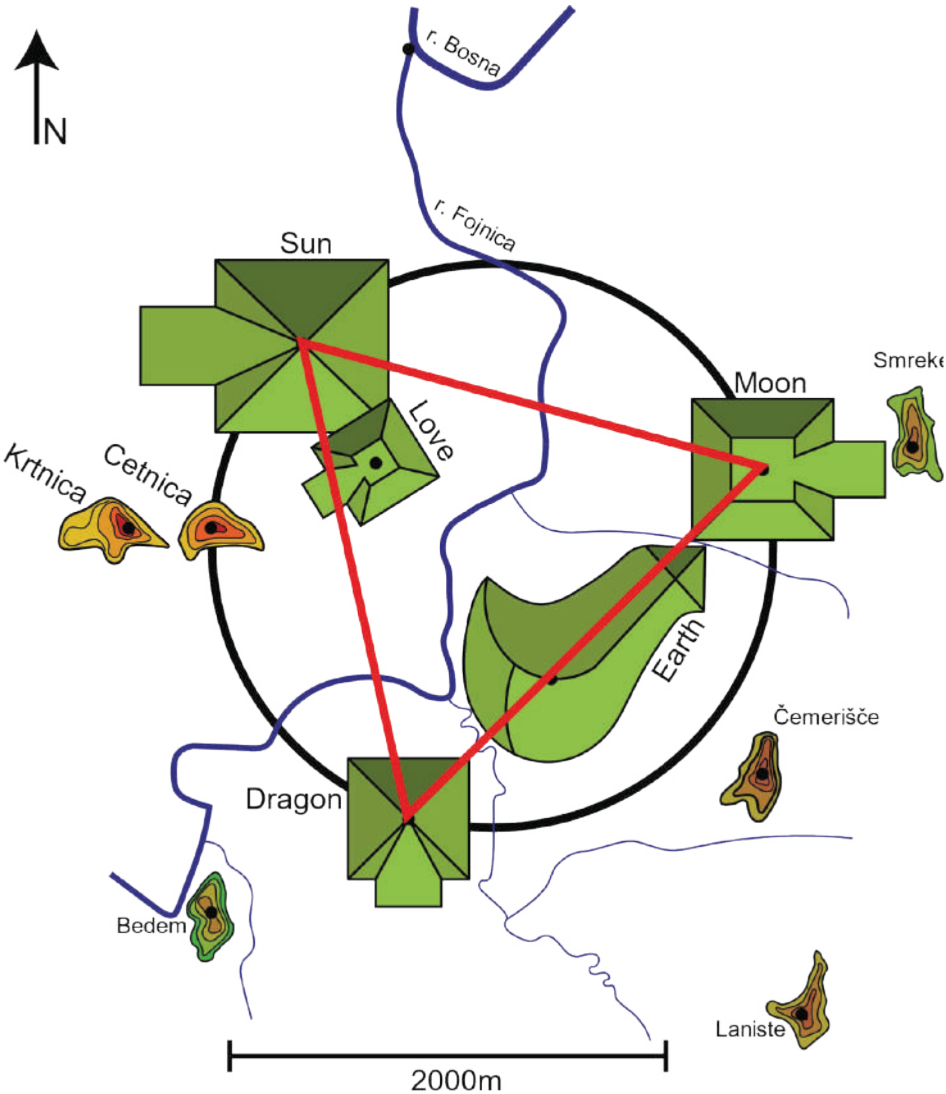
**LiDAR**

**DIGITAL TERRAIN MODEL (DTM)**

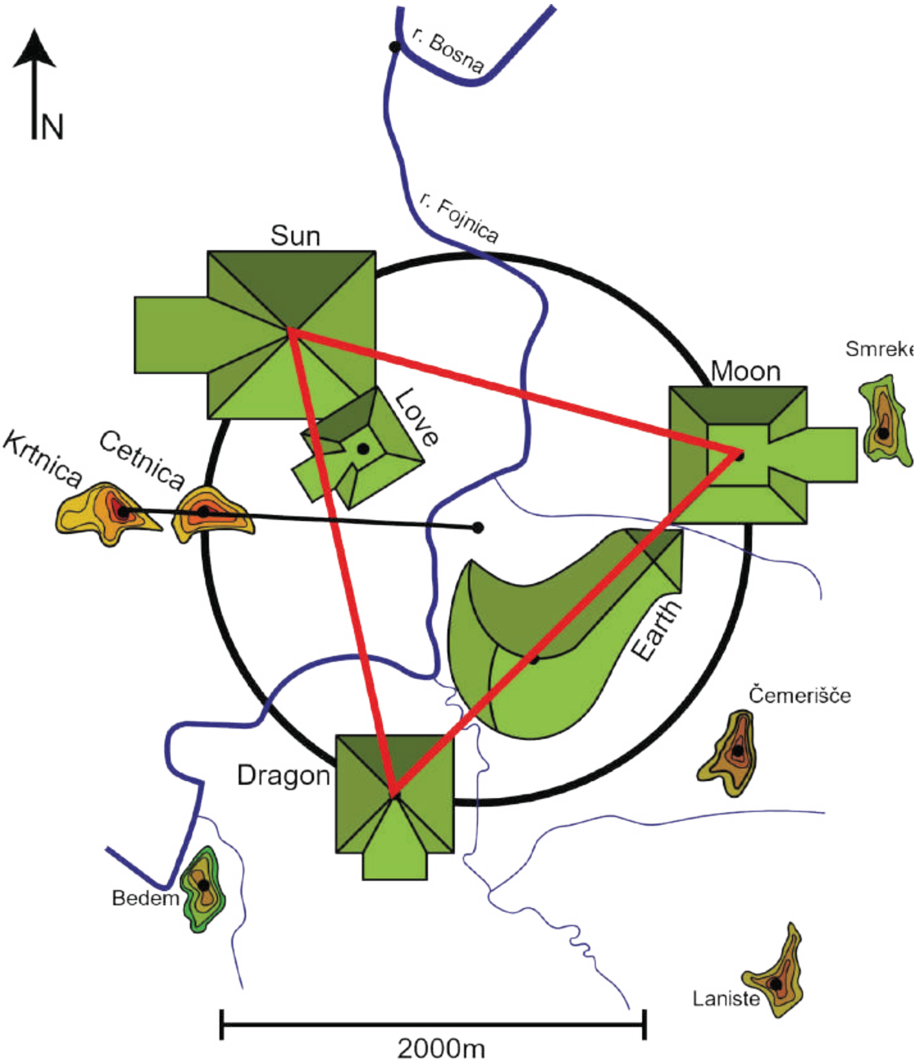



HISTORIC USE OF CIRCUMSCRIBED EQUILATERAL TRIANGLE

# THE EQUILATERAL TRIANGLE

# &

# THE CIRCUMCIRCLE

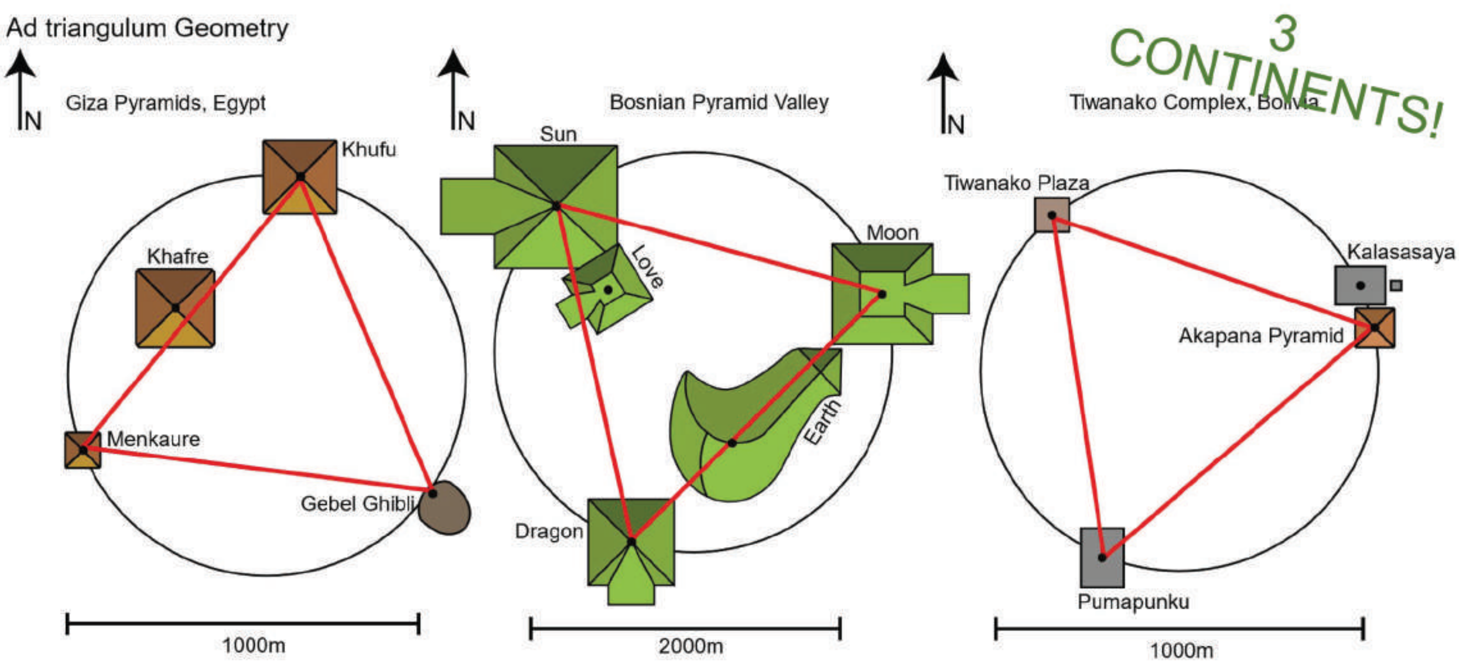



# THE EQUILATERAL TRIANGLE

# &

# THE CIRCUMCIRCLE

# EQUILATERAL TRIANGLE AT OTHER ANCIENT PYRAMID COMPLEXES



Pythagoras

Tetractys

Maths/Geometry

Papyri Graecae Magicae

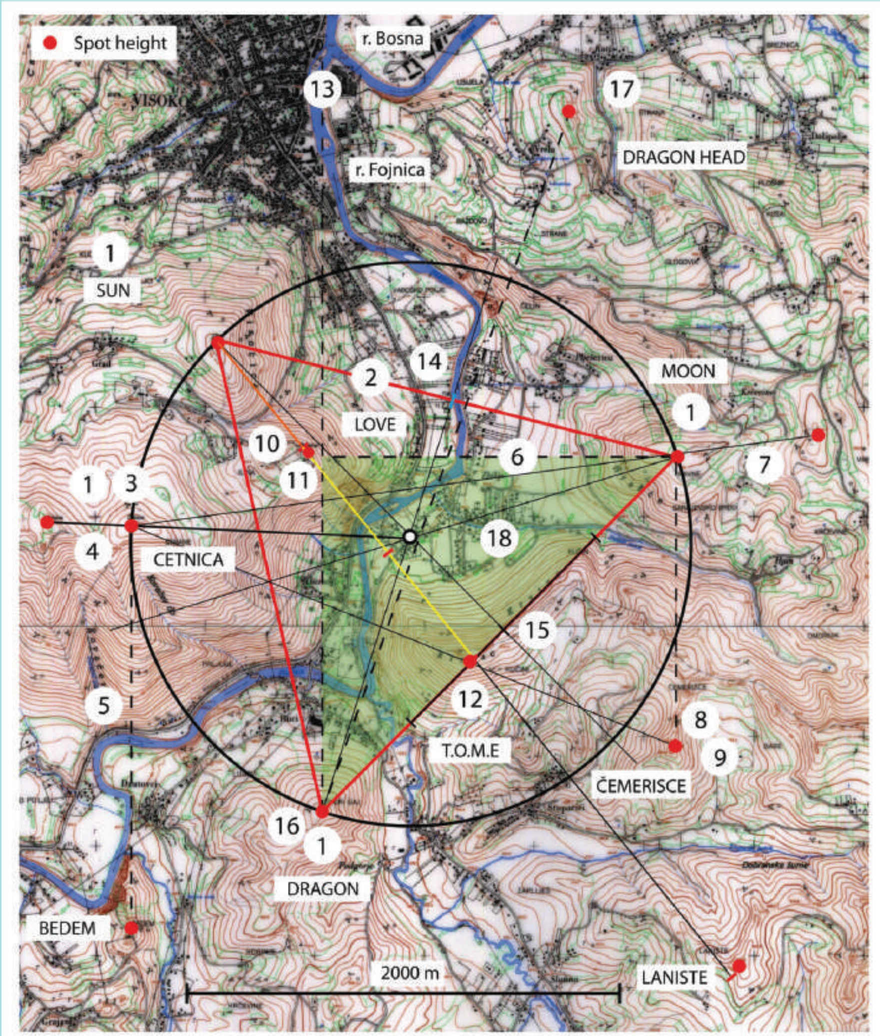
Ouroboros

Schools of wisdom

Venice, Italy


La Maddalena

Architecture

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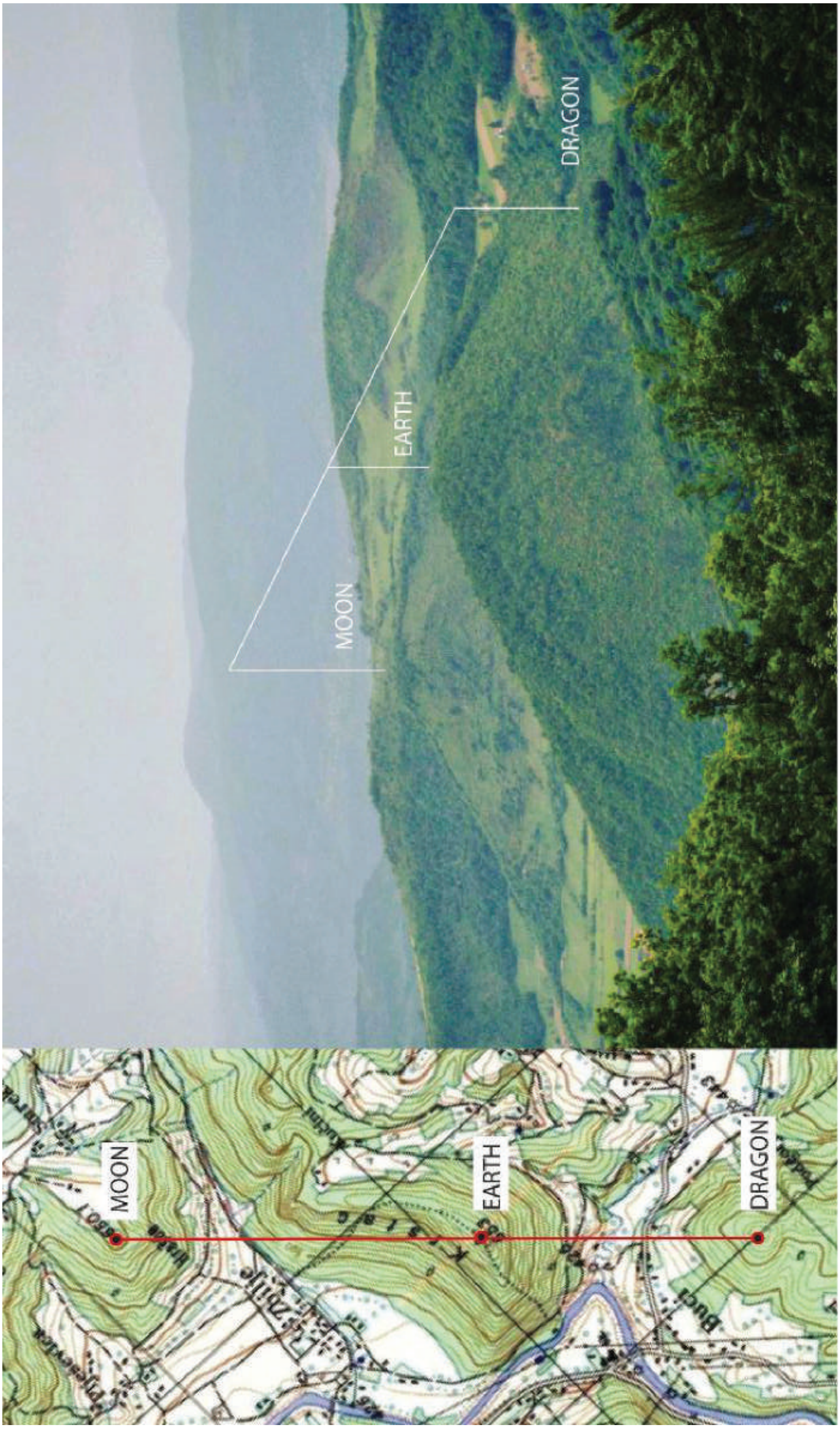
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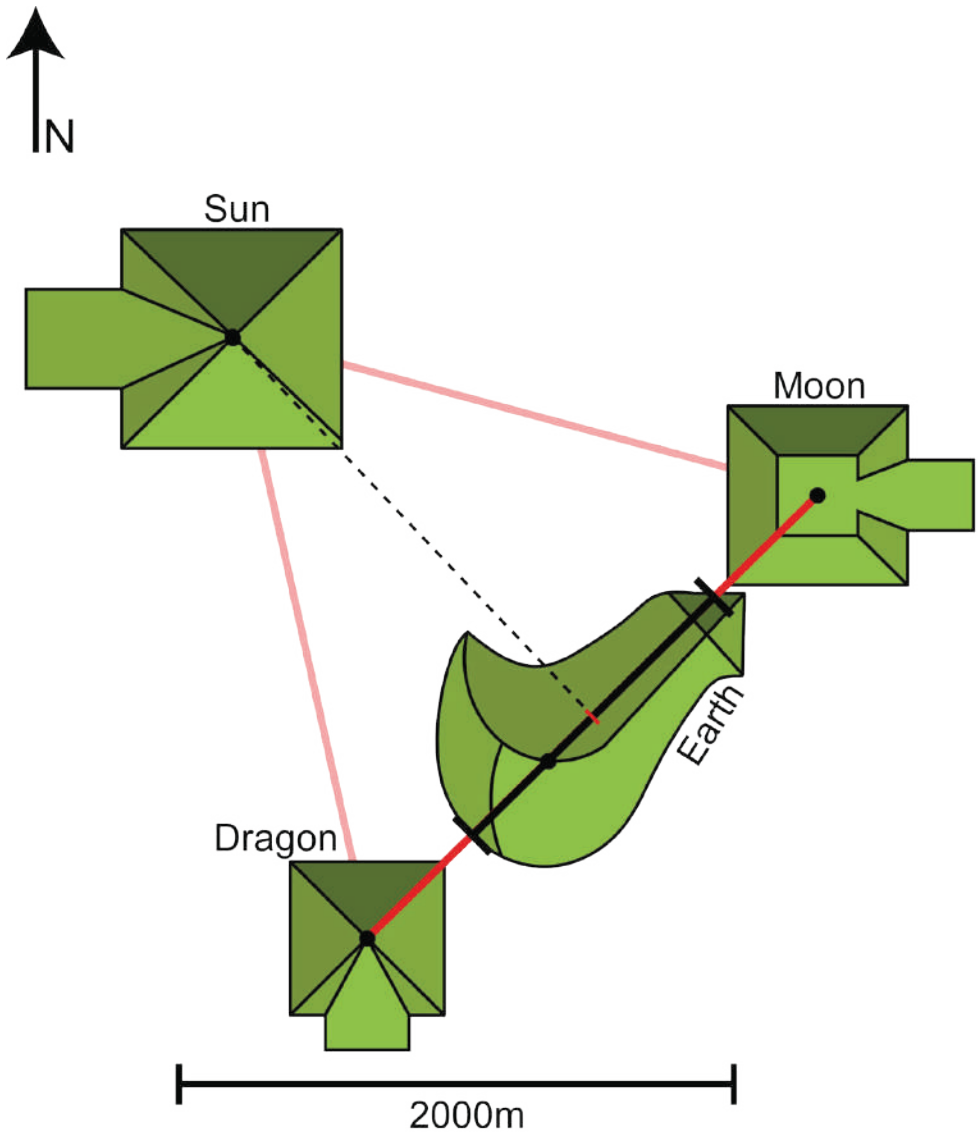


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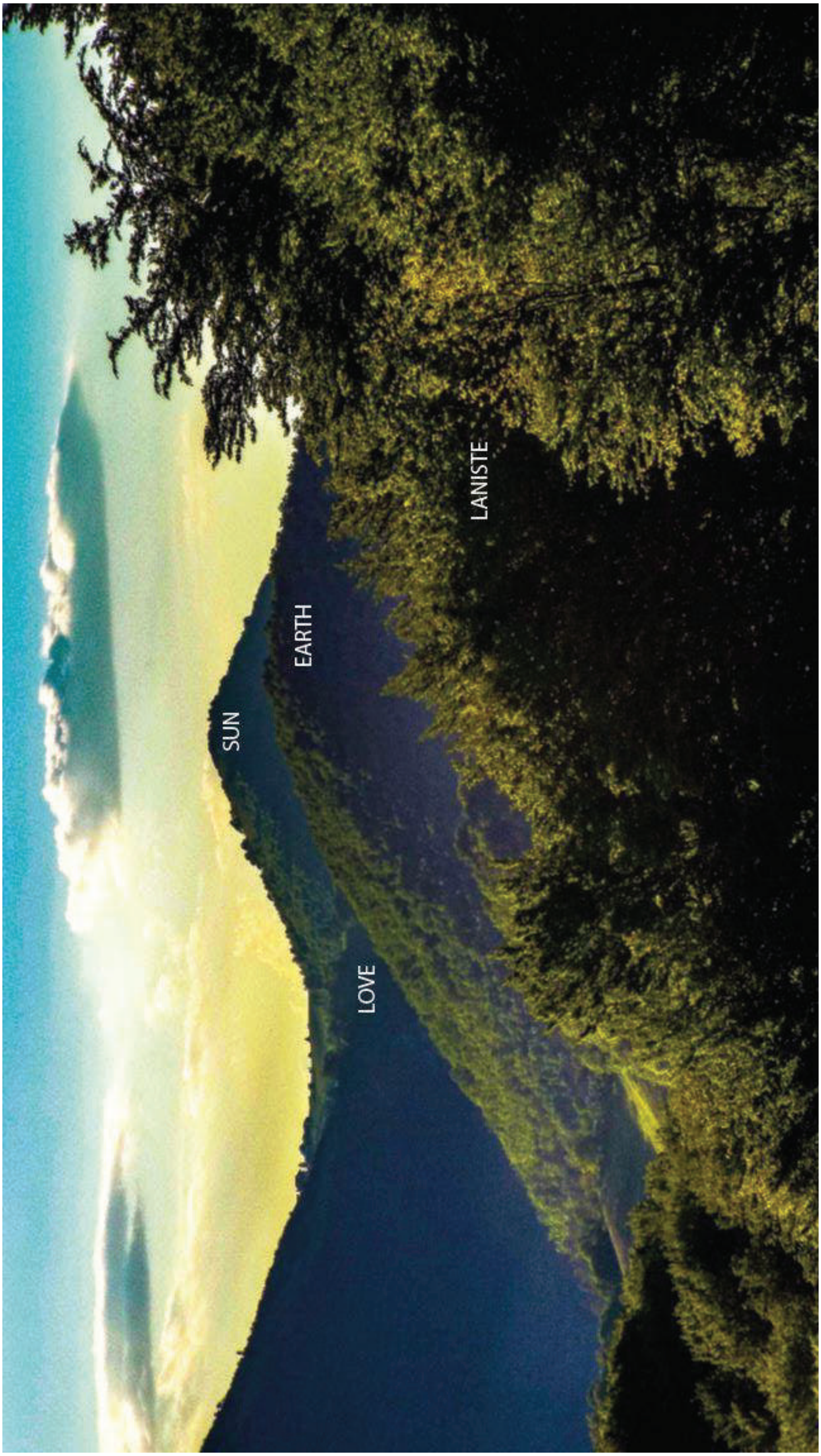
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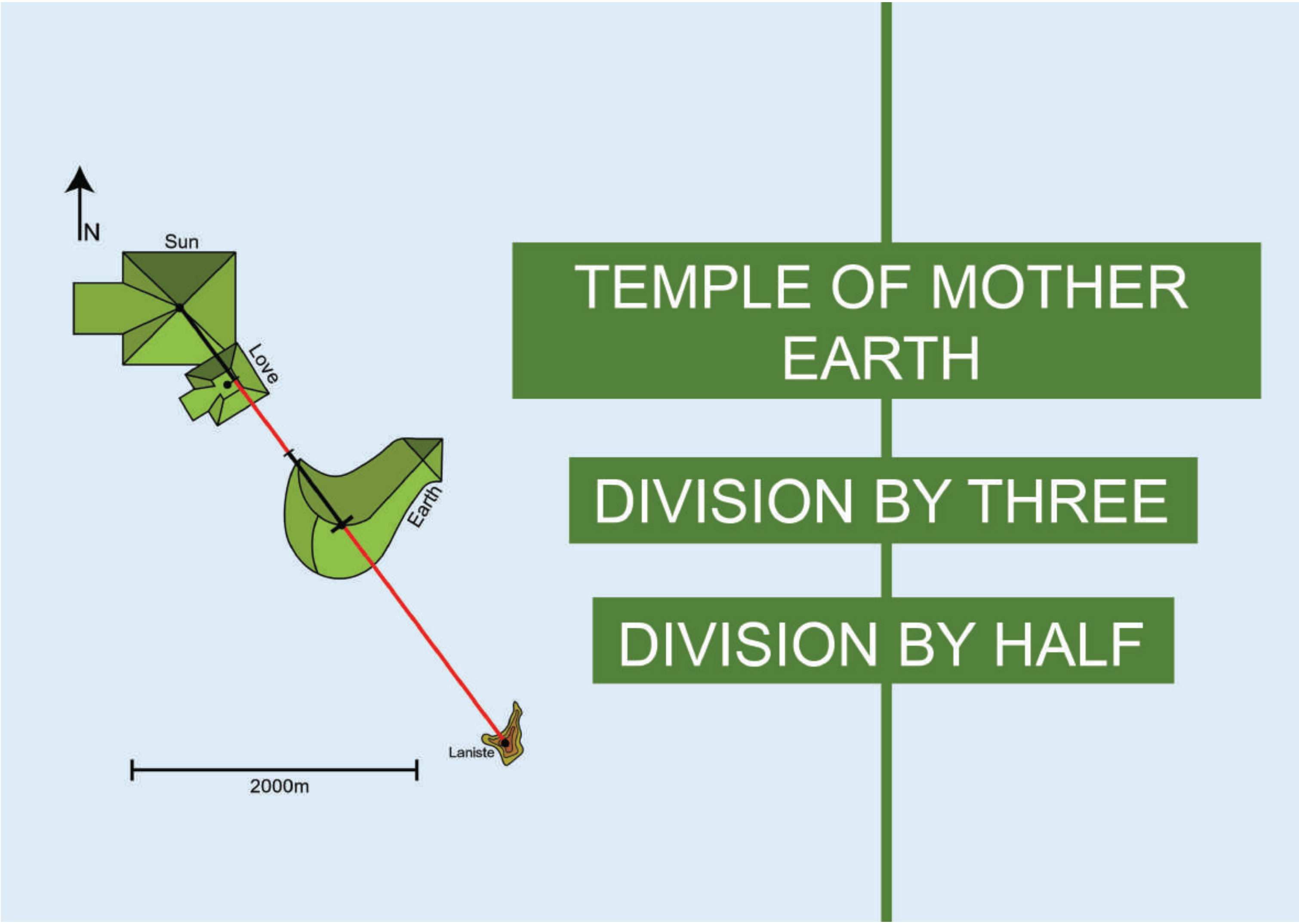
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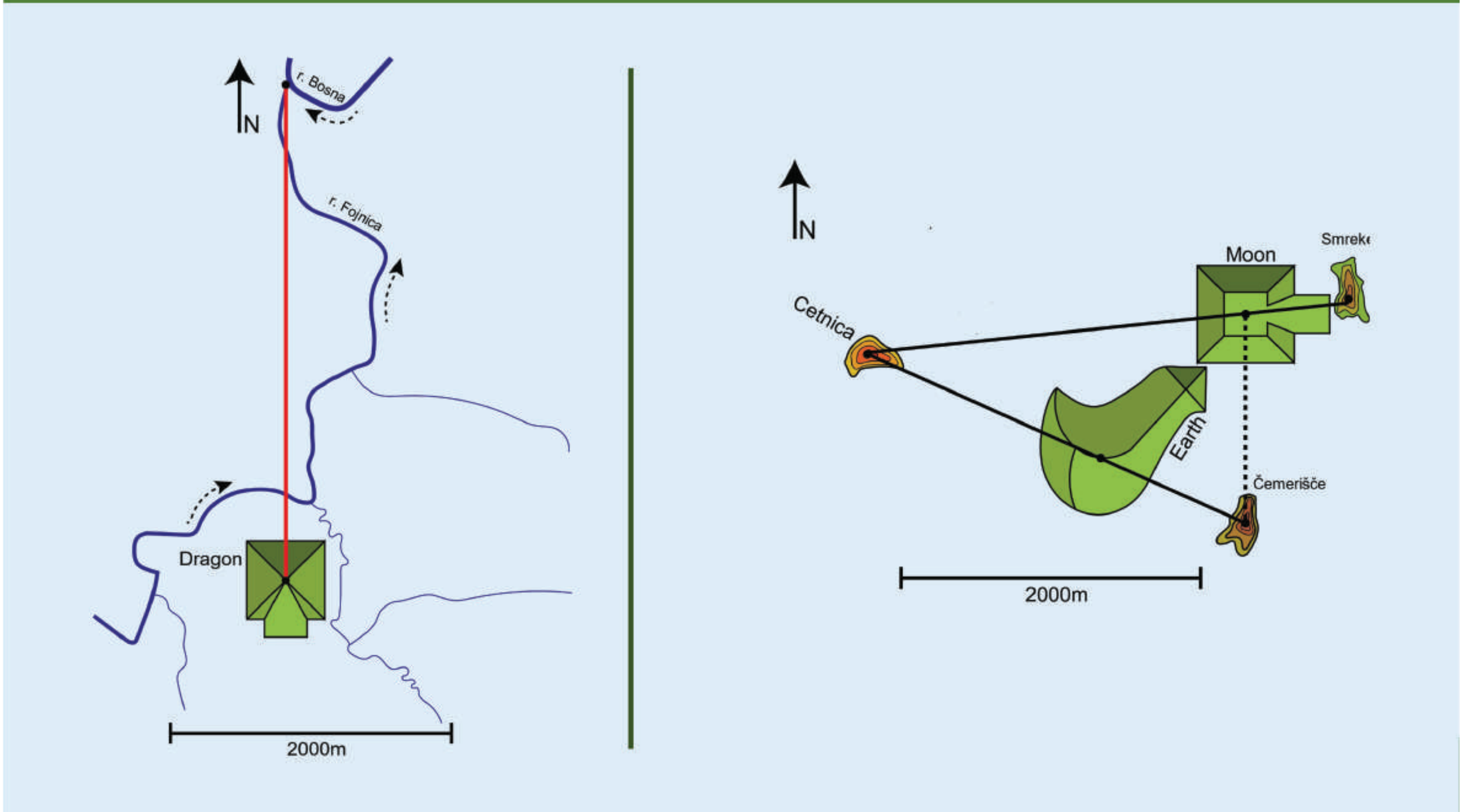
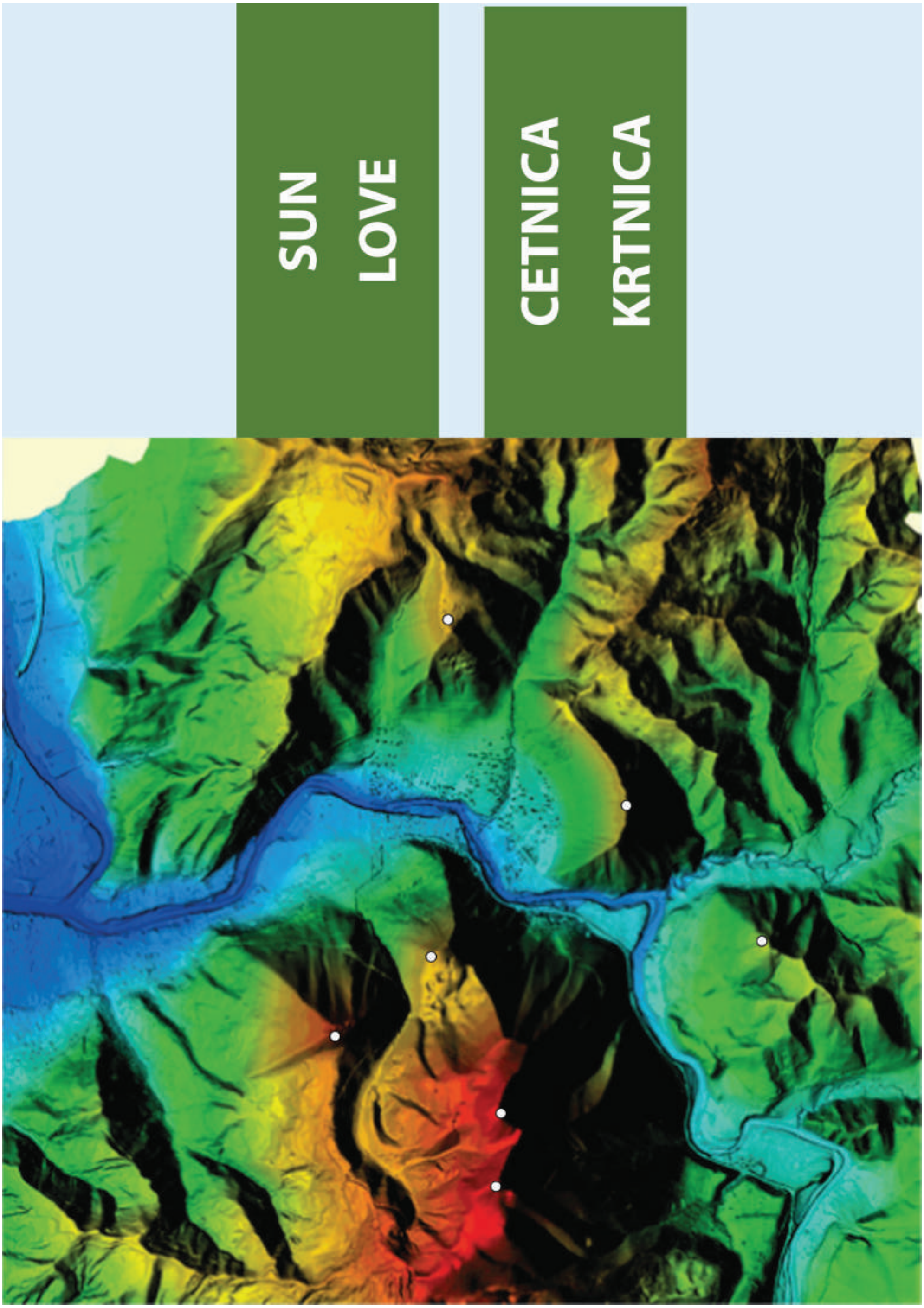
# A FEW MORE PLANER ALIGNMENTS…

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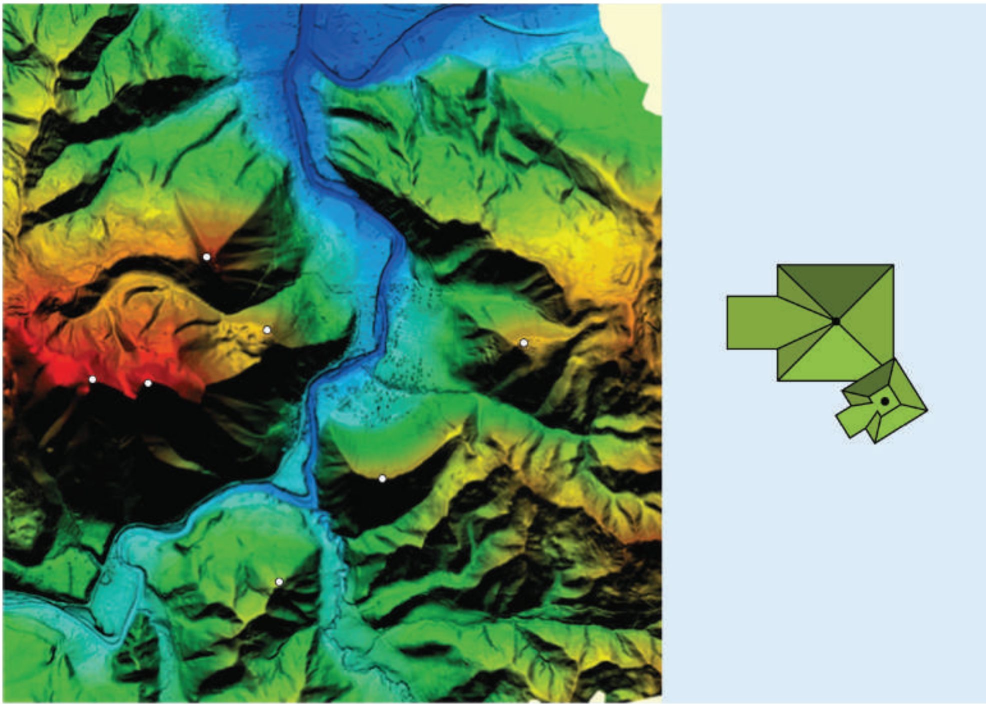

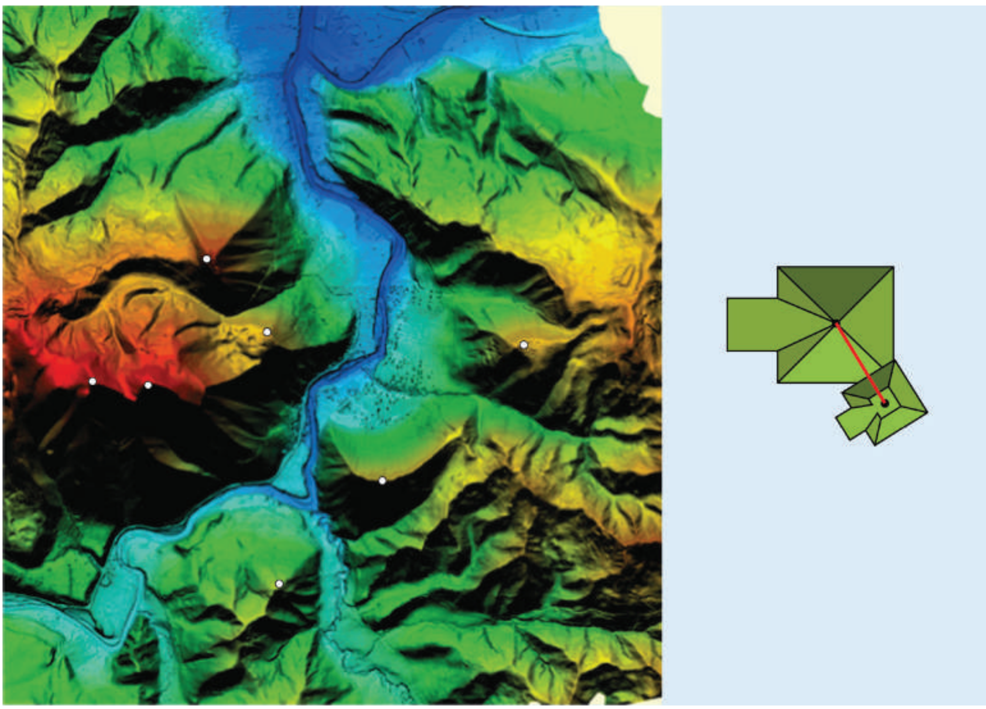

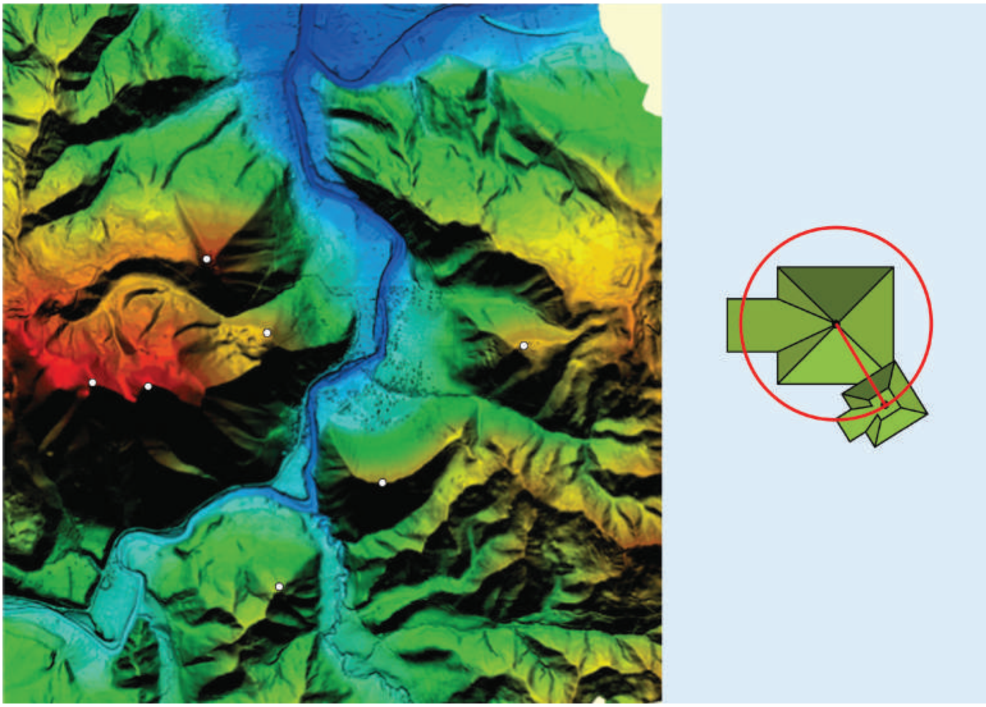

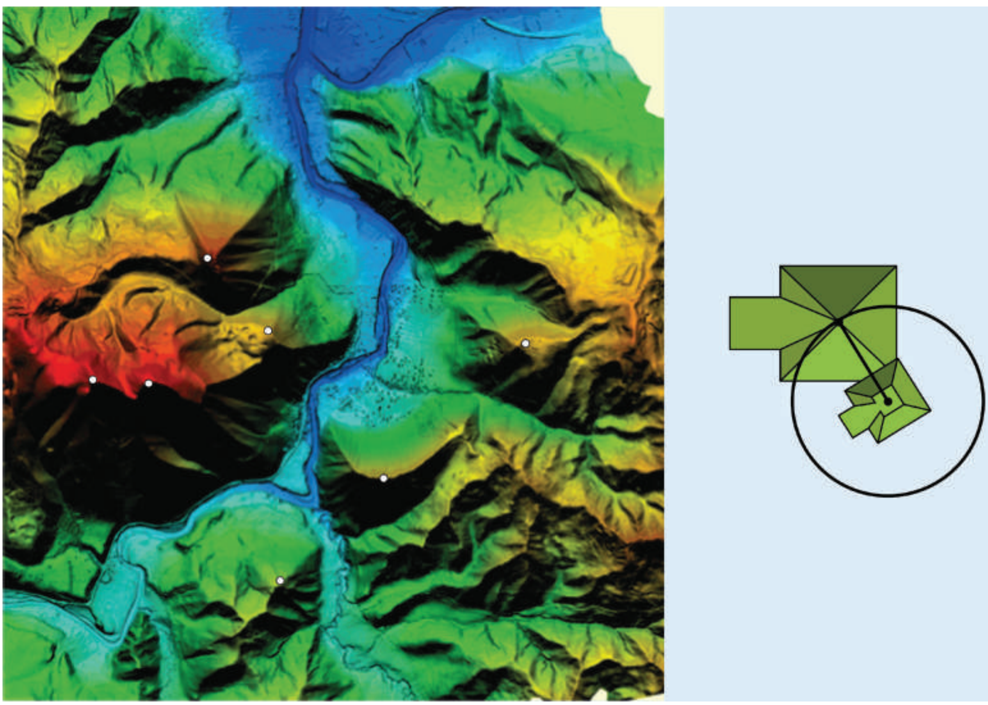

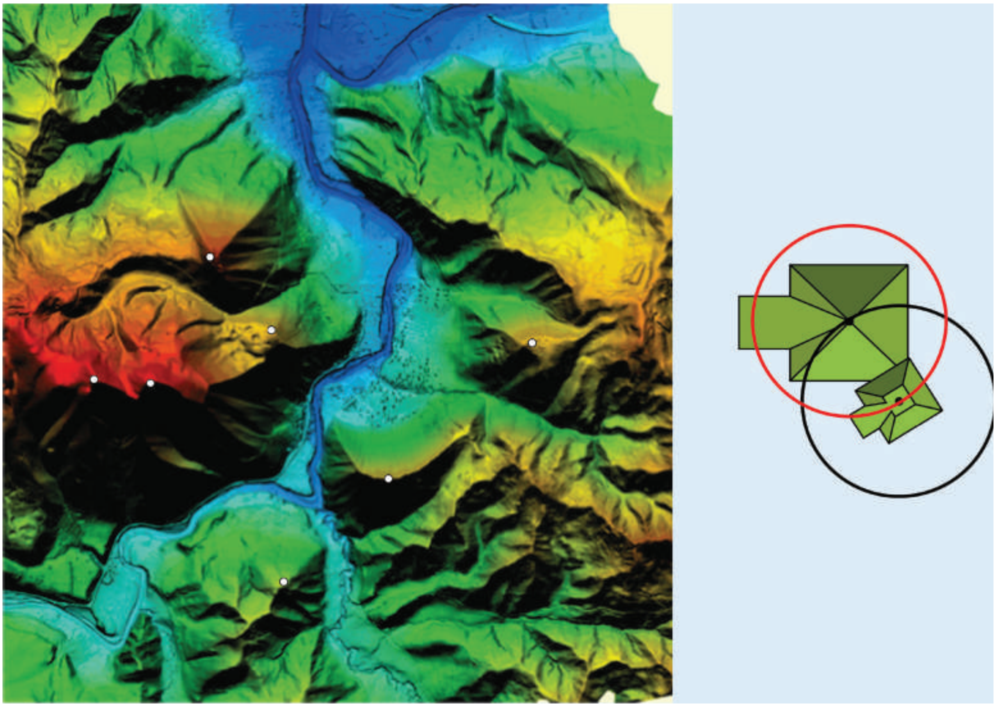

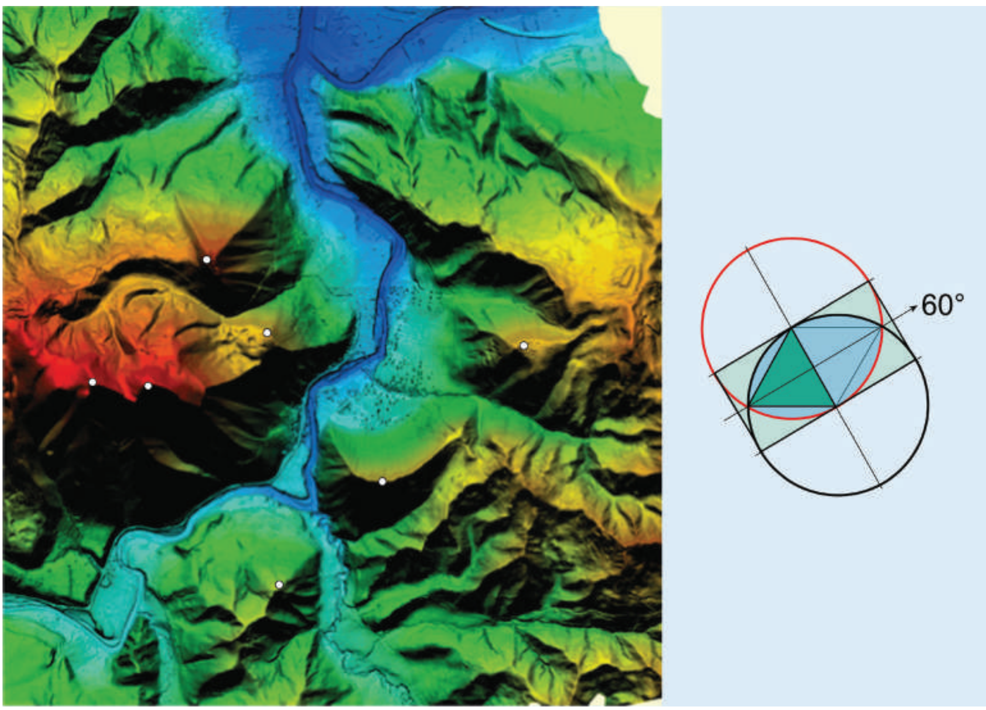
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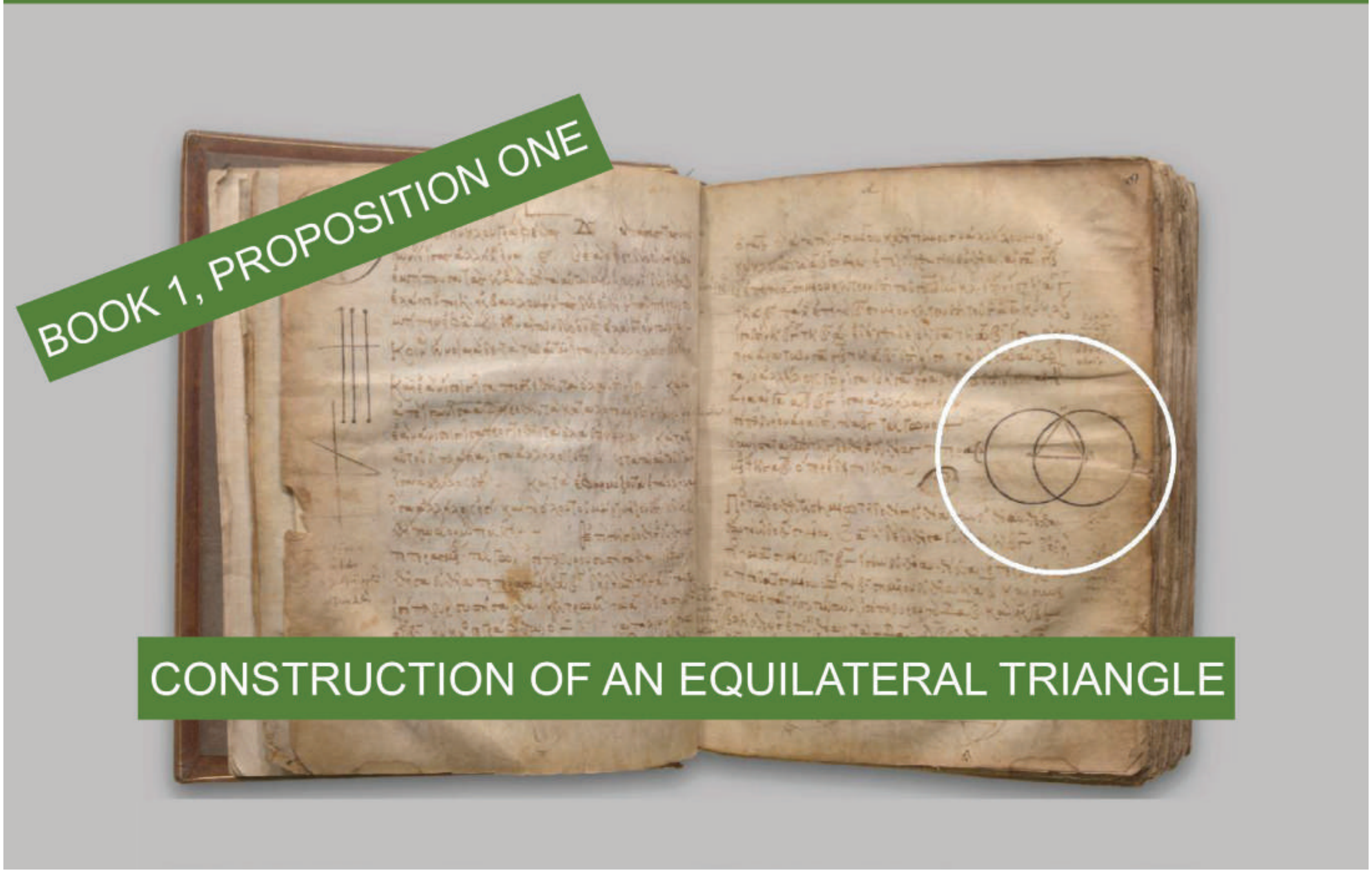
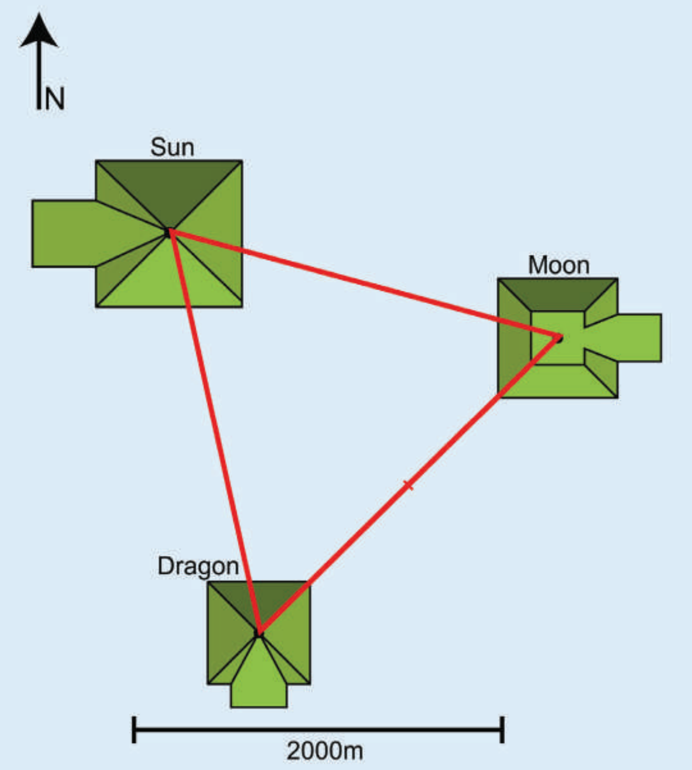
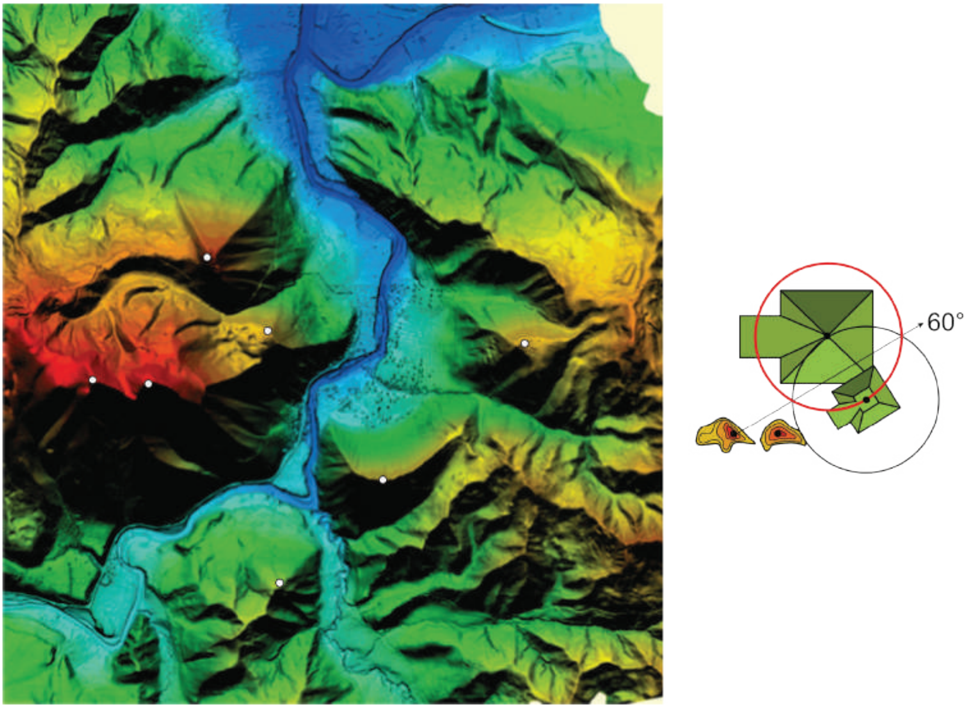
ANCIENT GREEK GEOMETER 'EUCLID'



## INTERNAL ANGLES EACH EQUAL 60 DEGREES

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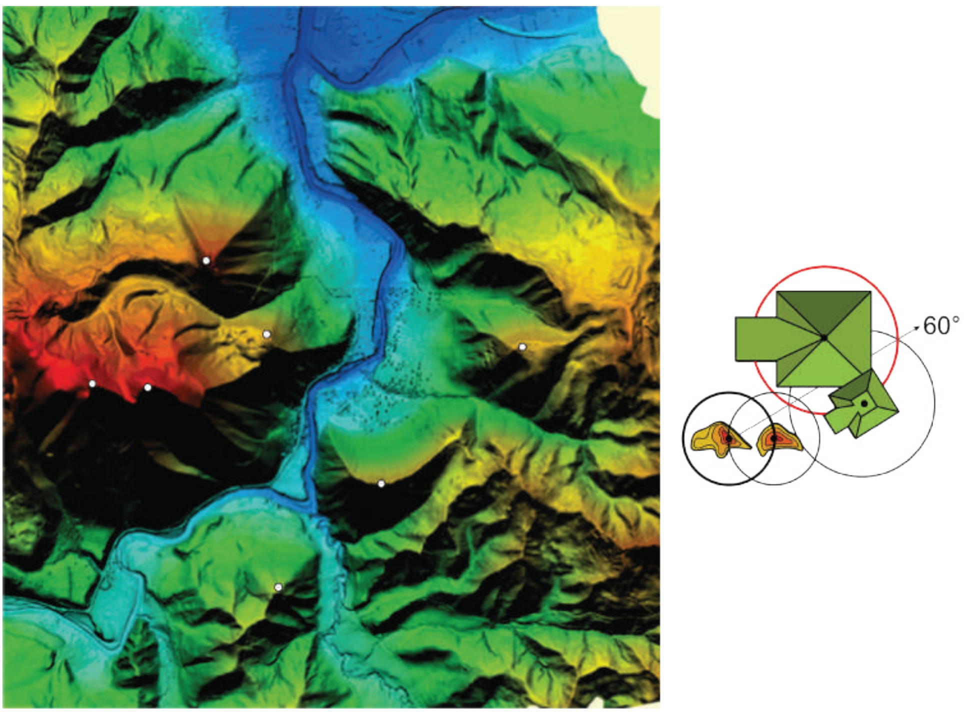
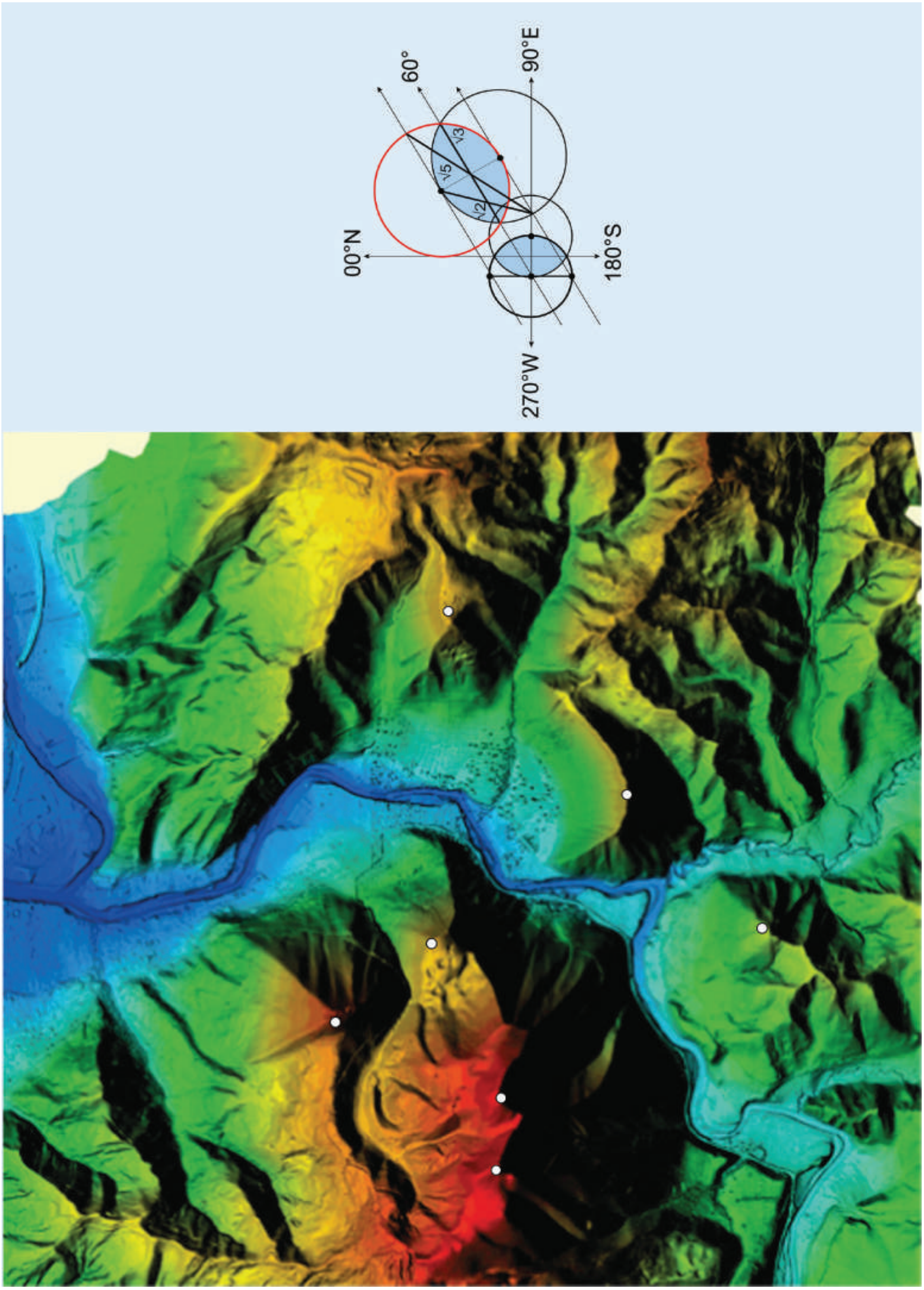
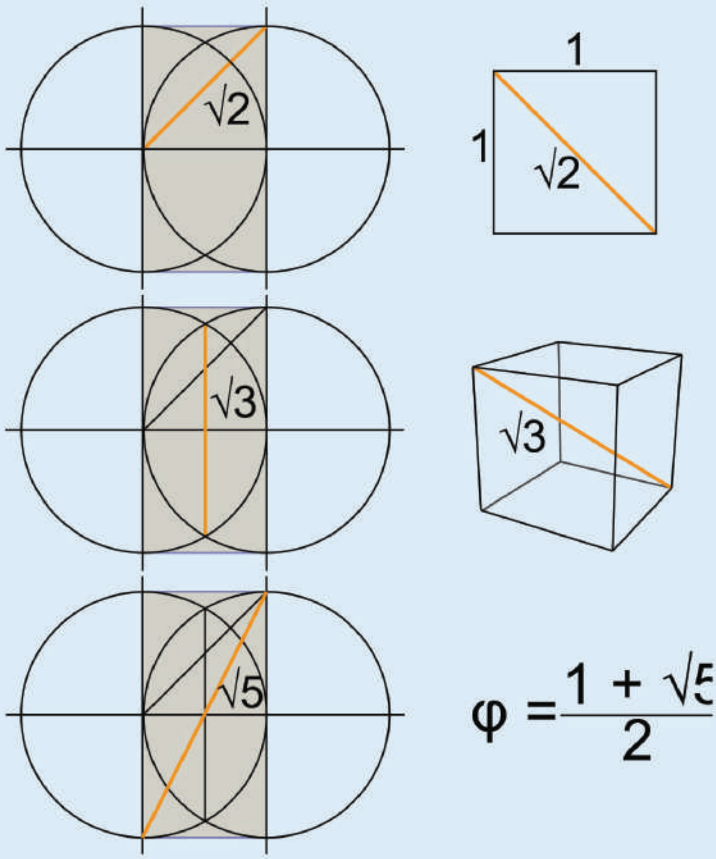
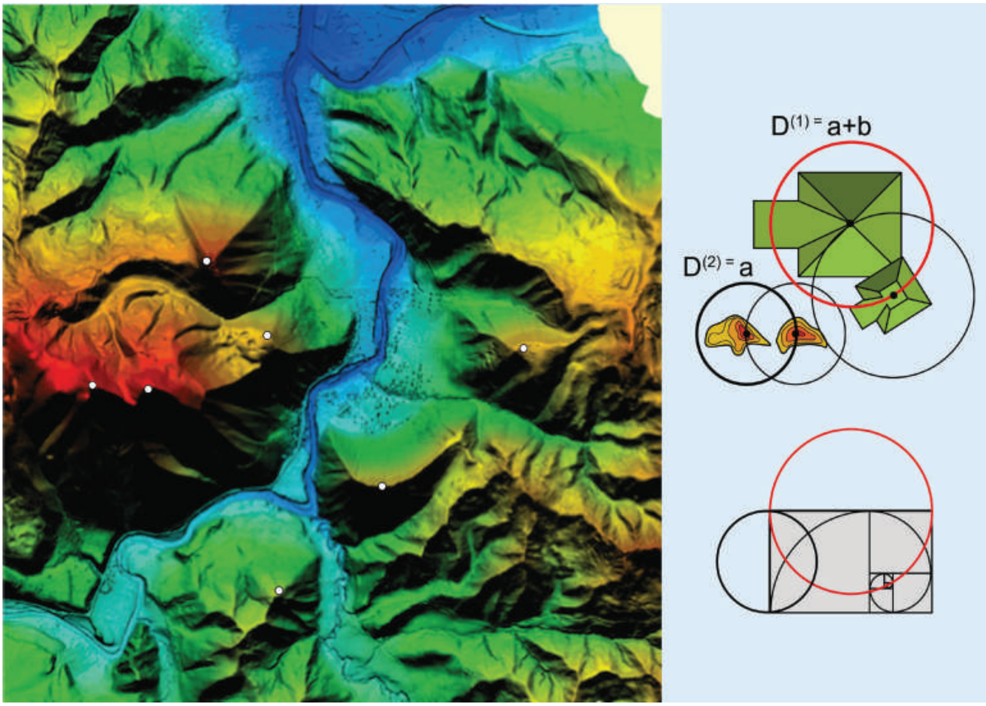

60°

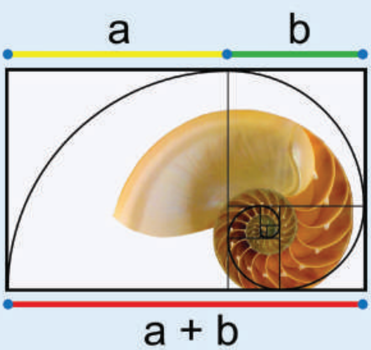

00°N
90°E
180°S
270°W
60°
√2
√3
√5

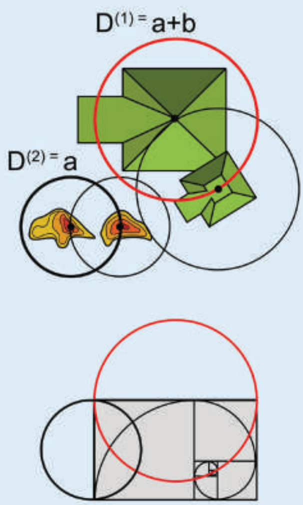
# SQUARE ROOTS DEFINED;





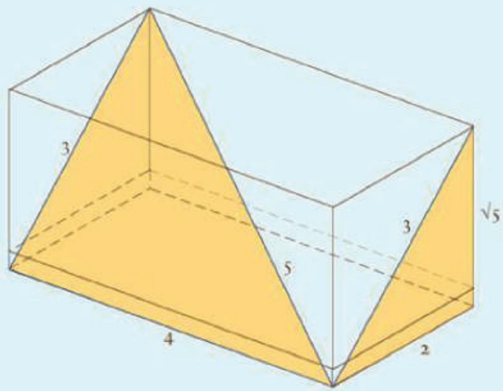

## THE GOLDEN RATIO;



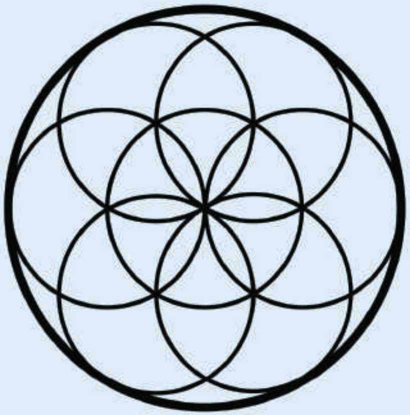

a+b is to a as a is to b

# PYRAMIDS AND THE GOLDEN RATIO;

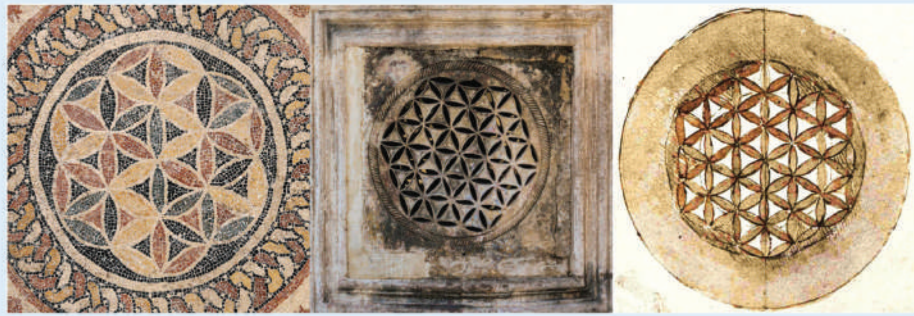



WITHIN THE GREAT PYRAMID, THE KING'S CHAMBER DIMENSIONS
ENCODE A 3, 4, 5 TRIANGLE AND A 2, 3, √5 TRIANGLE.
SIR FLINDERS PETRIE REPORTED THAT THE FLOOR WAS INSET
FROM THE WALLS, AND THUS THE WALLS CAN EXHIBIT TWO HEIGHTS;
ONE TO THE FLOOR SURFACE (17 FEET)
AND ONE TO THE TRUE BASE OF THE WALL (19.007 FEET).

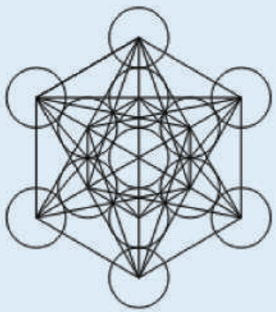
# THE SEED OF LIFE;



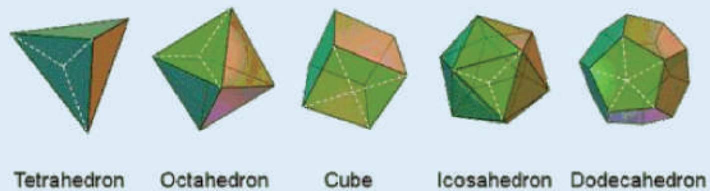
Seed of life



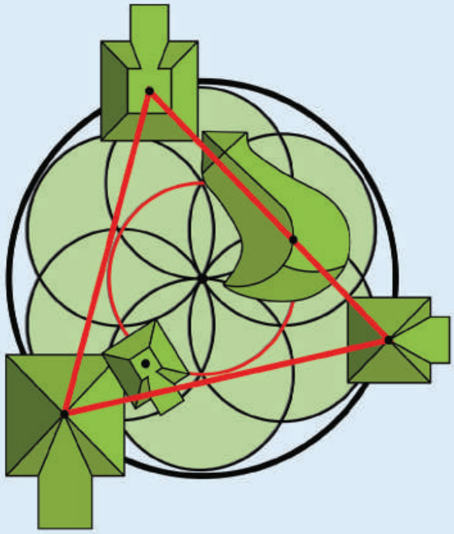
Flowers of life

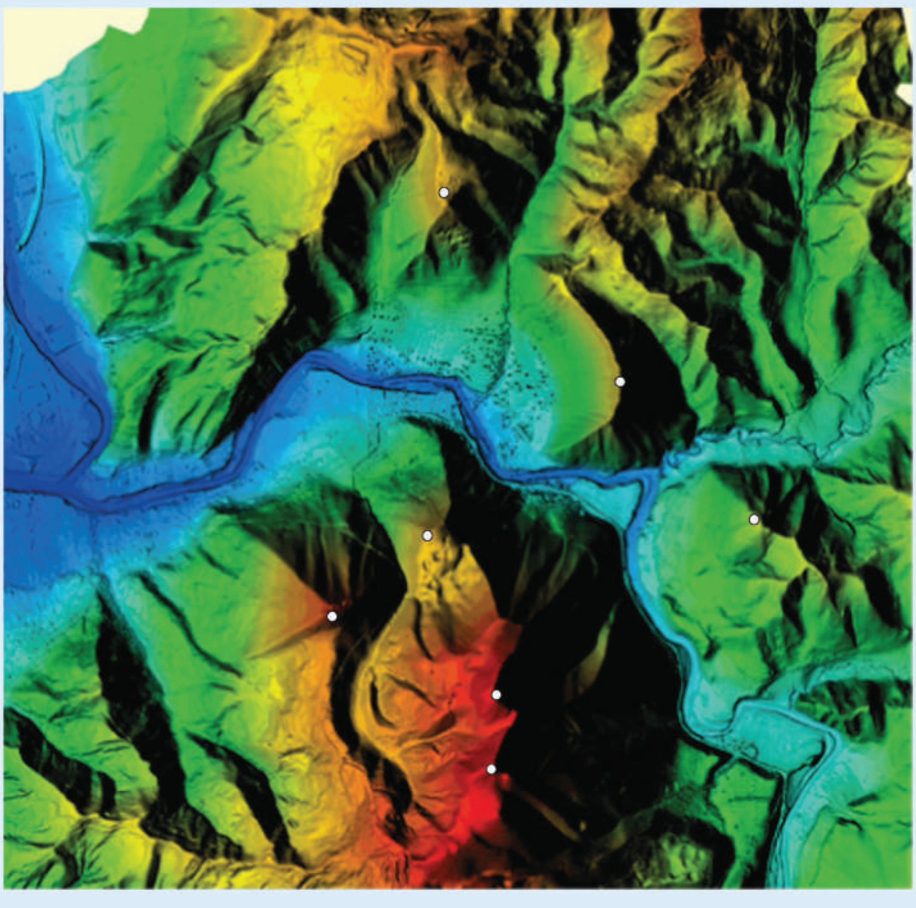


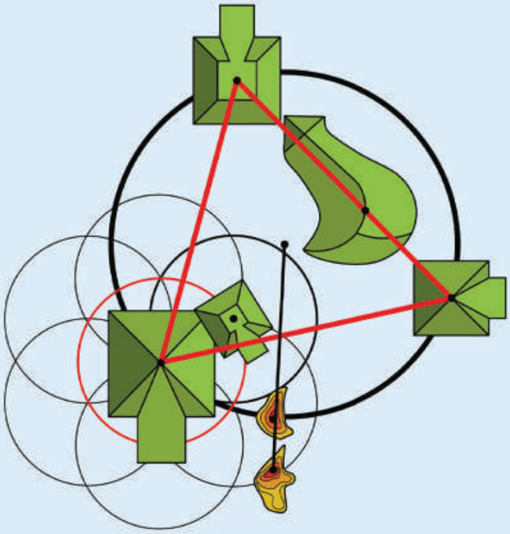
Metatron's cube

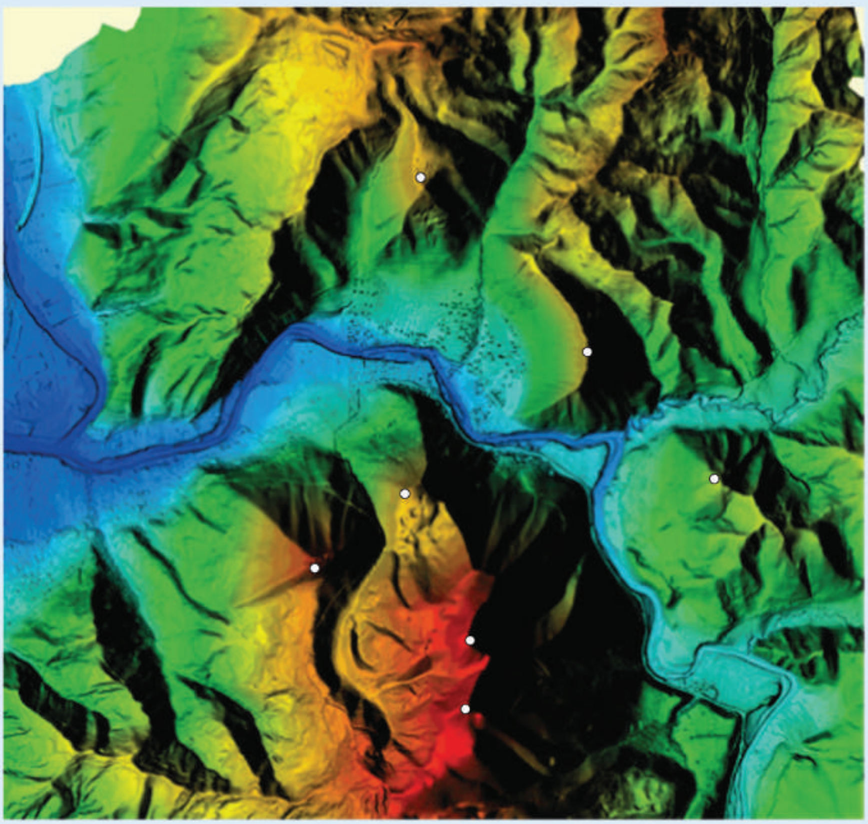


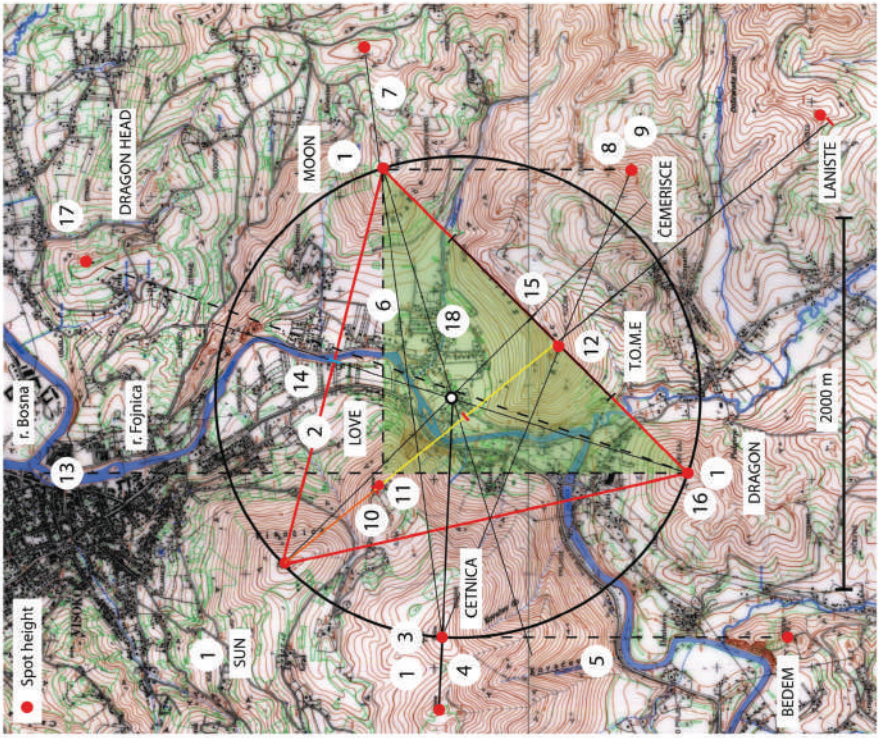

Platonic solids










Spot height
r. Bosna
r. Fojnica
DRAGON HEAD
MOON
SUN
LOVE
CETNICA
T.O.M.E
ČEMERISCE
LANISTE
DRAGON
BEDEM
2000 m