Ground follow-up to remote sensing survey of potential sites of archaeological interest in Visoko Valley, Bosnia and Herzegovina

Date: July 10, 2006. A.A.S., A.A.B, M.B.E., I.R.

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*) Hazim Hrvatovic, 1999 – Geoloski Vodic Kroz Bosnu i Hercegovinu
Milasin Miladinovic, 1976 – Pregled Paleogeografskih Odnosa Mesozoika Istocne Bosne, Geoloski Glasnik VIII.

1.0 Introduction:

This report is intended to highlight the occurrences of geoarchaeological interest on the locality known as Visocica Hill (Primary Target) and secondary sites at Pljesevica, Bucki Gaj and the Village of Ravne. This report is intended to serve a brief field evaluation of a working hypothesis that an “ancient, colossal buildings may exist in Visoko Valley.” Earlier evaluation of remote sensing data has suggested that several textural, geomorphic and structural anomalies exist in Visoko Valley and coupled with the lack of observable natural phenomena, it was postulated that they may be anthropogenic in origin. Considering relatively few hours spent in the field (108 hours), limited access to geologic literature and information pertaining to Visoko Valley, and overall unfamiliarity with the local terrain, this report should be considered more as a “reconnaissance ground-truthing” of remotely sensed data and determination of the geological baseline for some further studies. Final answers, acceptance or rejection of elements presented here are expected to come from the geologists and archaeologists actively engaged in all branches of this project. The author does not have the necessary expertise and insight to make any firm conclusions, so the results presented are intended only to clue the researchers into further, deeper analysis of the phenomena at hand.

2.0 Region:

The data available from the literature *) suggest that the Visoko Region is a portion of the Sarajevo-Zenica sedimentary basin, primarily Oligocene/Miocene in age. The basin is filled with the erosive detritus originating from the Mid-Bosnian Schist Mountains, intrusive massif of Mt. Vranica, Dinaric massif and fresh-water lacustrine sediments. Topography is generally shaped by up-to-resent-day tetonic processes (faulting, folding) and significant secondary erosion. The literature is suggesting that the area along the Bosna River was not subjected to glaciation, but that in addition to tectonic processes has sustained erosion related to Miocene-pliocene lakes, which are postulated to have been occupying the areas of the present-day valleys. The majority of the topographic “highs” observed in the area are considered to be sedimentary in origin with their present-day shape created by active and dramatic tectonism. The evaluation of the site by the team of experts from the Mining-Geologic and Civil Engineering College (Rudarsko-Geoloskog i Gradjevinskog Fakulteta (RGGF)) in Tuzla, Bosnia indicates that the observed geospatial anomalies are natural in origin and formed through “endogenous and exogenous” processes.

3.0 Hypothesis:

Based on the analysis of data from the commercially available spaceborne, airborne and geophysical data collected up to 2005, several notable textural, spatial, geomorphologic, tectonic and thermal anomalies are reported to exist in Visoko Valley. These occurrences are considered anomalous because their readily observable characteristics are difficult to sort and classify with only the natural processes (glaciation, erosion, faulting) in mind. Lacking additional information, and precise geo-dynamic models, there is a distinct possibility that some of the noted anomalies are a product of anthropogenic alteration to the terrain and if proven as such, they represent significant engineering accomplishments.

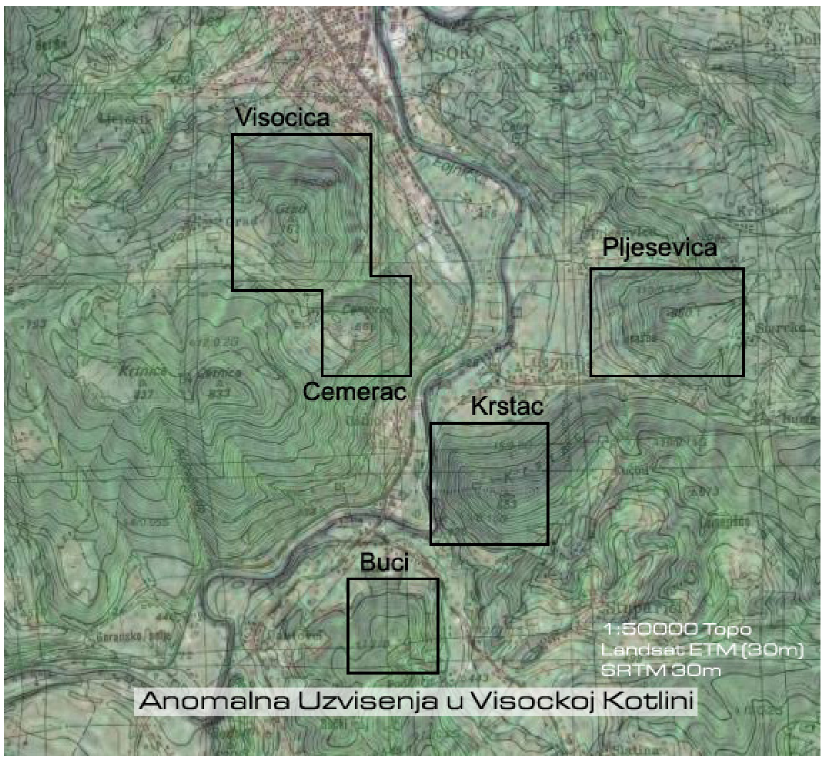


Figure 1 – Sites of interest in Visoko Valley

4.0 General Geologic Observation

The first impression is that the localities are primarily natural in origin, but may contain some artificial elements. It is difficult to determine the exact lines of separation where the natural ends and the artificial picks up, but the overall trend suggests that the localities are created by regional tectonism (folding, faulting) and then PERHAPS later shaped into pseudo-pyramidal shape (with some unknown purpose in mind) on an existing natural base

4.1 Stratigraphy

The “polygon” formed by the hills Visocica, Pljesevica, Cemorac, Krstac i Bucki Gaj, located in the south-central portion of the Visoko Valley, can be subdivided into 6 distinct sedimentary units: alluvial/colluvial material (recent), lacustrine (varvic) sediments, dolomite, coarse conglomerate, sandstone, micritic mudstones and siltstones on the bottom of the exposed stratigraphic ladder. Majority of the mounds in the area are comprised of the “big three”: conglomerate, sandstone and mudstone in the base. The strike and dip of the sediments tends to vary as one moves to the north or approaches the vicinity of observable fault structures – all suggesting a rather dynamic post-sedimentary tectonic movement in the area.

The observed sedimentary facies were classified using Uden-Wentworth scale with regards to size, texture and origin of clasts and petrologic classification described in *'Petrology of Sedimentary Rocks', Robert L. Folks 2nd Edition, 1974, Hemphill Publishing Company*. Considering that the general geologic chart (OGK) from 1962, 1:100,000 does not attribute particular detail to the target area (Figure 2a), the author has developed a temporary field-based classification of the observed units, shown with explanation in Figure 2b.

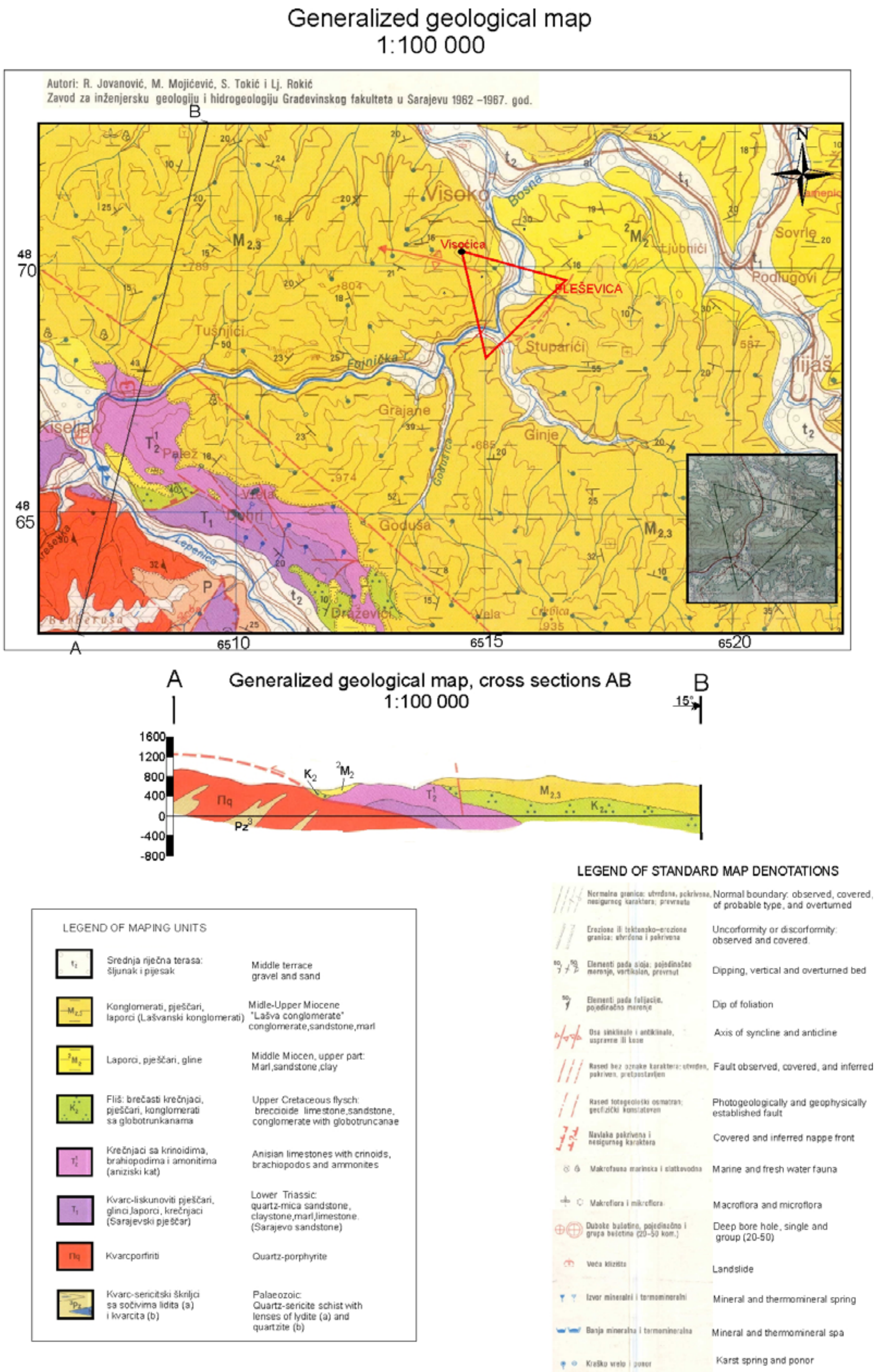


Figure 2a – Generalized 1:100,000 geologic map. Target area marked with the triangle.

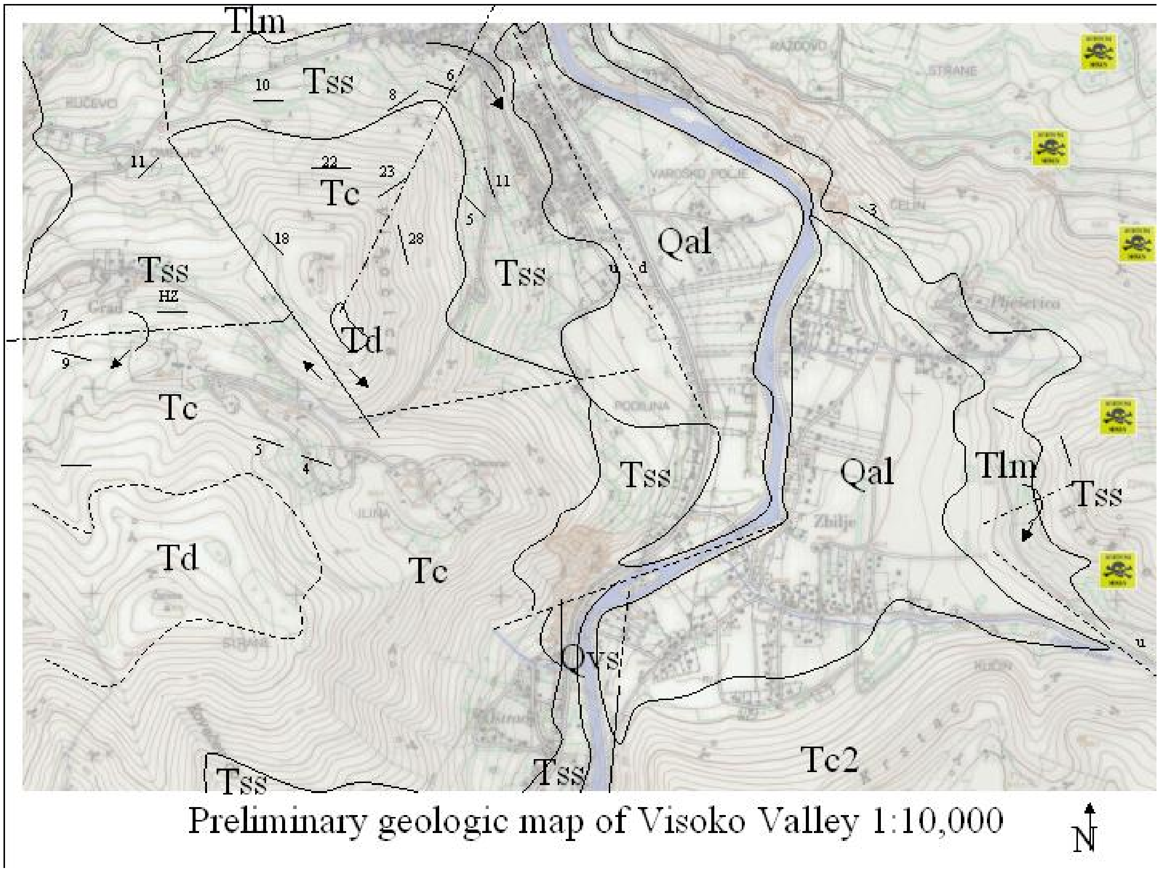


Figure 2b – Preliminary, field-reference geologic map constructed for orientation and site-understanding purposes only. The author has created field reference units to match observations listed in this report as other units of Lasva series were not discerned to a sufficient level. Note mined areas are marked with yellow squares – THE AUTHOR STRONLGY ADVISES AGAINST VENTURING INTO THOSE AREAS!!

On the bottom of stratigraphic ladder (Tlm), along the banks of River Fojnica, there is an exposure of micritic, mudstones and siltstones (Figure 3a). Occasional lenses of sand and clay concretions occur throughout the sediment section. The sediments mildly react with HCl and the measured thickness is about 8-12m in places with gentle dip of about 8 degrees to the north-northwest. The upper contact with sandstone is in the form of erosive disconformity and there are indications of paleosurface indicated by ripple marks and channels, which were later filled by the fluvial sandstone. These sediments also occur in (extend to) the base of Pljesevica Hill where they are exposed in the current digs. The thickness of the section there is about 50m and the dip is subhorizontal in the base, but the strata become gently foliated as one moves up the section along the side of the hill. Some presence of organic material is noted between the laminae, but there are no observable coal-beds in this locality.

The sandstone (Tss - Figure 3b) is mainly coarse textured (with some minor changes in granularity throughout the section) and manifested in the form of blocks, varying in thickness from about 10 – 42 cm. The composition of sandstone grains is mainly quartz, with some minor elements of calcite manifested by mild to moderate reaction with HCl. Occasionaly some hematite and goethite staining was noted on the blocks exposed to weathering at one point. Several deciduous leaf impressions have been noted in the sandstones. The leaves are mainly from the Quercus, Fagus and/or Castanea genus indicating that the paleodepositional environment was most likely temperate fluvial environment. The dip of the sandstone changes from subhorizontal West of Visocica, then becomes northerly (8-11 degrees) in the base of Visocica, then it shifts to the North-NorthEast as one approaches Pljesevica and then becomes subhorizontal again until reaching the fault-contact with conglomerate where the dip becomes pronounced and off to the East (20 degrees). The sequence of sandstone is upper-coarsening manifested by the presence of gravel-sized pebbles and then the unit grades into massive conglomerate. The upper contact with conglomerate is either gradual-coarsening sequence or a normal fault contact.

The coarse conglomerate (Tc and Tc2) is mainly comprised out of clasts ranging 3-10cm suspended in a calcareous-sandy matrix. The clasts are mainly comprised of dolomitic cobbles with some quartz, greenstone and diabase fragments. Conglomerate comprises the most of Visocica as well as Bucki Gaj, Krstac and Cemorac. The measured dip of the conglomerate varies even more than the sandstone. South of Visocica, across the possible fault line, the dip is southerly, then becomes roughly subhorizontal on the west side of Visocica and then dips to the North (11-23 degrees) and Northeast (16-28 degrees) on the northern and eastern slopes of Visocica. There are notable regional variations in the composition of conglomerate shown on Figure 3c. Also Krstac conglomerate (Tc2) is a bit more massive, and less calcareous than the other conglomerates.

Figure 3c – regional conglomerate variations: (from the left) tunnel in Ravne, flat blocks on Visocica and rectangular blocks on Visocica.

The elements of dolomite (Td) found on the top of the southern side of Visocica are mainly in the form of float although some apparent outcrops exist in the area (about 1-2m in size on Mt.Cetnica). It is impossible to measure dip and determine whether the dolomite is in-situ or the exposures represent later addition to secure the terrace upon which the medieval town is built (Figure 3d).

Figure 3d – Dolomite with signs of conglomerate.

Lastly some possibly quaternary varvic sediments (Qvs) are noted on the southwestern portion of Krstac and in the central portion of Visoko Valley near the bridge that crosses river Fojnica en-route to Pljesevica. These laminated varvic sediments form on an erosive surface of conglomerate and are concentrated in a small area which was probably a location of small dammed pond formed as a result of tectonic damming of Fojnica river. The sediments are about 5 m thick and exhibit seasonal variations. The pond was obviously not long lasting (several hundred years), but the presence of micro-cracks and faulting in the sediments is important to understanding the recent tectonism in the area.

4.2 Structure

The entire region (Figure 4a) is cut by numerous forms of faults, folds and zones of stress accommodation between the main fault zones, connected to the Busovacki Rasjed (Busovaca Fault). According to the linear features noted on the satellite imagery as well as some overall structural trends noted on the 1:100,000 geologic chart, the faulting seems to be related to the mild subsidence of the basin-axis towards southeast. The locality seems to be affected by the right-lateral shift on Busovaca fault (Hrvatovic, 1999) which resulted formation of along-side and diagonal accommodation structures in Miocene sediments as a result of basement shift. Some elements of folding are also noted in the sediments, particularly in Pljesevica as well as West of Visocica. It is also possible that some larger, regional folding and tilting of the sediment might have taken place in the process.

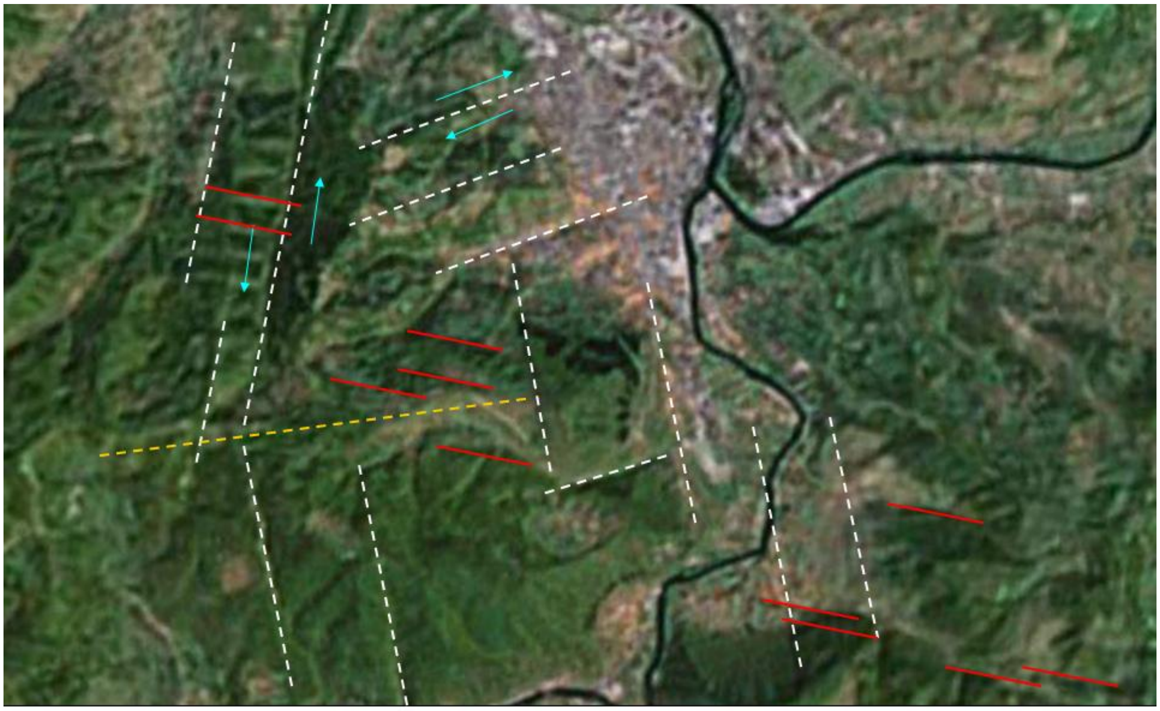


Figure 4a - Possible fault mesh drawn on LANDSAT ETM image. Note apparent fractures (red) followed by northwesterly trend of lineaments and then northeasterly shift. Apparent foliation trend is outlined in yellow

Figure 4b – Exposed fault surface on the northwestern edge of Visocica. Presence of slickensides, cataclastic breccia and re-healed fractures are indicators of constant reactivation of this fault surface and possibly very recent movement.

Closely related to the observed structures is a set of faults that determines the shape of the valley and position of the hills. The main fault is believed to be somewhere in the central portion of the valley, east of Visocica with an approximately northerly strike and normal motion. Several smaller lateral-offset faults are likely originating from the main structure and strike diagonally to the west and northwest. Some minor kinematic indicators have been noted in the areas of cataclastic breccia south of Visocica, which suggests their relatively recent re-activation. Re-activation of these structures may explain why there are elements of landsliding and collapse along the southern and eastern portions of Visocica (Figure 4b).

Also notable are two larger folding episodes noted on the north-eastern edge of Visocica and along the western plateau. The strata exhibit different dip direction on the opposite sides of the folding axis, which suggest that as a result of movement on the fault system some folding may have resulted as well. Some minor folds of same general axial orientation are noted on Pljesevica and may be smaller analogues to the overall stress direction in the area.

The stereonet analysis of all observed fractures (Figure 4c), slips and stria of slickensides exposed on the fault surfaces reveal predominantly northwest-southeast trend of stress propagation in the area, which also correspond with the frequency and strike of lineaments observed on the satellite imagery (Figure 4a). A location of secondary shear corresponds with an approximate attitude of the surface bedding cracks observed on Pljesevica and discussed further in Section 7.

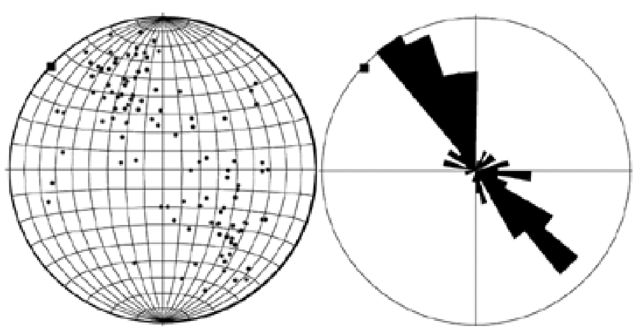


Figure 4c – stereonet and rose diagram analysis of observed structures in the area. Note relatively uniform NW-SE propagation of stress and minor orthogonal stressed forming from the principal axis. Compare with 4a.

5.0 Primary Target Visocica

5.1 General Description

The Visocica hill is about 365m tall and is comprised of sandstone base (lower third) and conglomerate mass. The conglomerates are massive in places and manifested as flat sheets of polished conglomerate with a relatively steep dip. The rock surface is covered by about 5cm (top) to about 65cm (bottom) thick layer of soil. The soil is relatively uniform layer of clays and organic histosol (humic soil) towards the top.

5.2 Peculiarities

The peculiarities of Visocica are its relatively well defined northern, western and eastern sides. The northern side is very triangular and the overall dip of conglomerate blocks changes from the west to the north to the east as one crosses over the appropriate edges. Furthermore, the overall dip of the conglomerates is much steeper from the sandstone base and the surface is well polished, without the signs of tectonic or glacial polishing. A closer examination of surface reveals no striations that would be indicative of mechanical polishing, which suggests that these blocks have been most likely subaeral and exposed to significant meteoric water weathering in the process. Another anomalous occurrence is the presence of well defined conglomerate blocks, which appear to have been laid on top of each others and shaped in a pseudo-rectangular form. The size of these megalithic blocks is about 240 x 100 x 40cm with well defined edges and apparently cut-off clasts (the clasts that do not break the plane of the edge), giving an impression as if these blocks have been casted.

The overall thickness of soil partially supports this finding, because the available pedologic model for the area suggests that accumulation/creation of clay/humic layer about 2.46 cm annually in the first 10cm and then due to compaction drops to 0.68cm annually with further logarithmic progression in each additional 10cm. Taking in account the overall erosive loss of about 1.26cm anually, we could guesstimate that the cover thickness 60cm would be at least 1800 years old. Considering that the true models of soil accumulation in Visoko are still unknown and dependent on numerous local factors, it can only be speculated that the conglomerate plates have been buried for at least few hundred years. Whether this has any acraheological significance is uncertain.

Last anomalous feature is the presence of 1-3m wide terraces about every third of the way up Visocica on the northern and eastern sides. There is an apparent break in slope at this “terracing” and then continuation all the way to the top. These “terraces” are clearly visible on the overhead imagery and dense-elevation-contour maps, but at present, it is inconclusive whether they represent sedimentary, erosive or anthropogenic features.

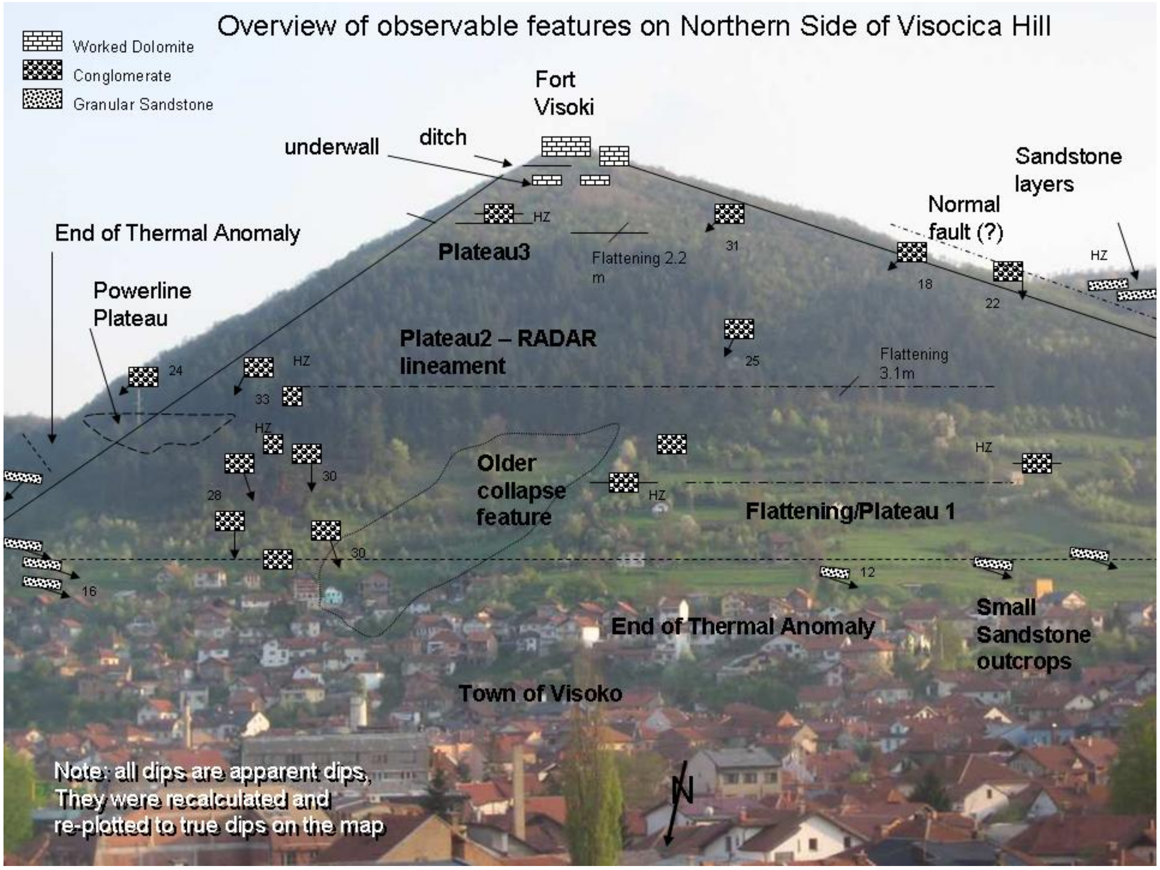


Figure 5a – Some of the elements noted on the northern side of Visocica.

5.3 Structures

Discussing all of the possible structures observable on Visocica (and Pljesevica) would surmount to a daunting task, however it should be assumed that majority of the observed elements are somehow related to the regional stress propagation envelope discussed earlier. Generally, it is assumed that the neogene sediments are following the trend of overall basin deformation to the Southeast, hence the structural elements observed will be explained in that context.

The most apparent features are of course triangulated sides, sharp edges of Visocica hill, the apparent change of dips in neogene sediments and relatively flat “access plateau” from the west with numerous sandstone terraces. Based on the apparent attitude of the observed layers and kinematic indicators observable on the southern and western sides of Visocica, the author is speculating that the hill itself was created in a fashion of a tilted, faulted anticline along the principal East-West fold axis (western plateau) and then later tilted and possible rotated into a Northeast-Southwest direction (main body of Visocica) along the set of observed faults. The western contact between sandstone and conglomerate (on Visocica) appears to be alongside lateral fault, however, the contact on bottom of the northern and eastern side as well as the western "access plateau" appears depositional.

The faults appear to have been reactivated at least several times in the recent history, as evidenced by the apparent shifting the apparent position of freshwater springs on the northwestern and southeastern portion of Visocica. Furthermore there are evidence of collapse features on the bottom of the northern side and along the entire southern side (evidenced by tumbling, scars, significant volume of colluvial material and fans). There are two recorded instances of landslides in the area one in the 1950s, and one in the early 1900s when the first forest was planted on the northern side to help mitigate the unstable slope. The historical records also suggest that the medieval fortress on top of Visocica had a well constructed southern flank with an access platform. Only hints of that platform exist today and it is believed that it too was destroyed by relatively recent seismic movements.

Figure 5b – slickenside occurrence and cataclastic breccia on the fault surface south of Visocica.

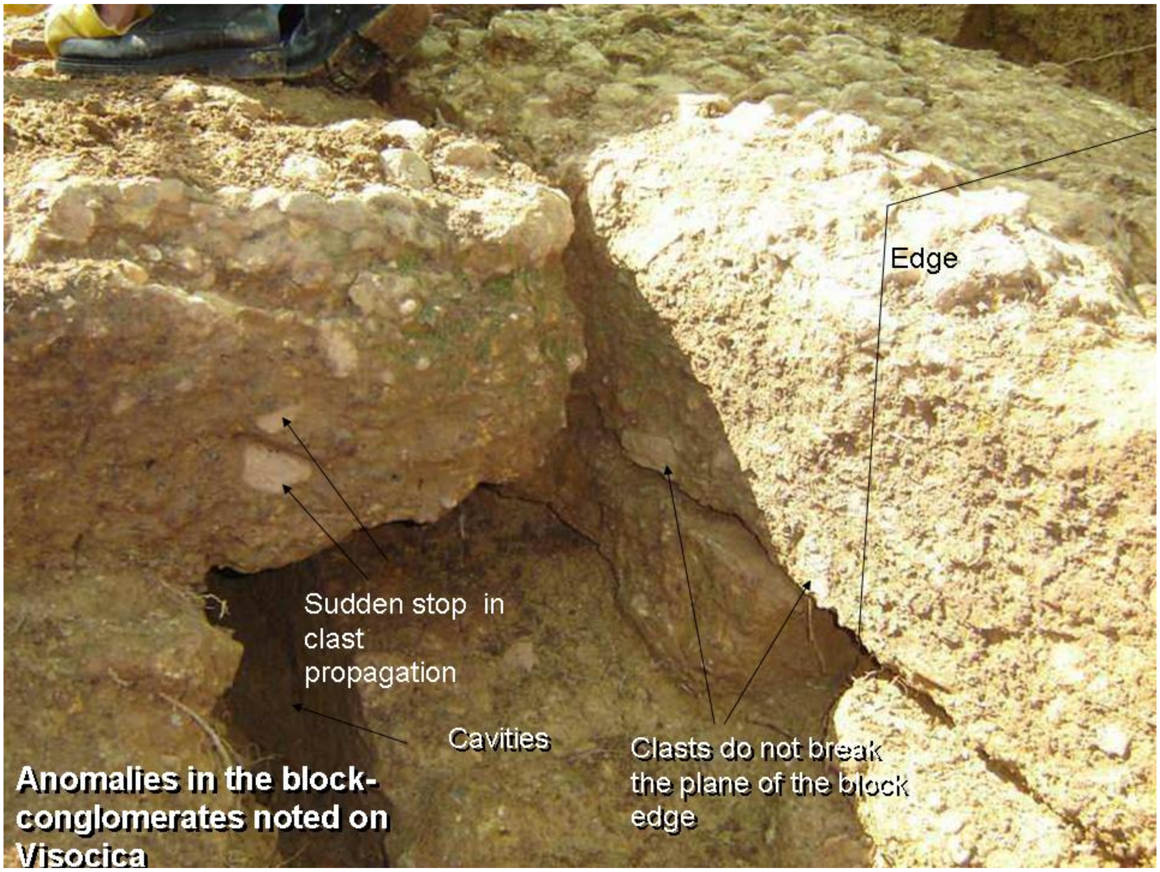


Figure 5c – "Casted" look of the conglomerate blocks and the occurrence of cavities in the structure. Note that these cavities may be the chief result for the apparent low thermal inertia of the structure noted on the thermal infrared data.

6.0 Pljesevica (Secondary Target)

6.1 General Description

Overall, Pljesevica is about 80m shorter than Visocica and appears somewhat conical in shape, with three somewhat defined triangular sides and one that attaches it to the range due east, dubbed the "access plateau." The eastern portion and top of Pljesevica are heavily mined and littered with UXO, hence any venture into those areas is STERNLY DISCOURAGED.

Geologically speaking, Pljesevica is split into approximately even halves: the base comprised out of laminated marl/mudstone and massive sandstone towards the top. In the course of exploration several areas in the base of Pljesevica have been exposed by digging, so a better insight into sediments and structure is possible. Some elements of anthropogenic structures have been found on Pljesevica in a form of rectangular hole and supporting wall. These elements fall into the realm of archaeology and will not be discussed in this report, however what will be discussed are the areas dubbed “pavestones,” which are fairly interesting from the structural standpoint of evolution of Pljesevica and the area in general.

6.2 Structure

The area drawing greatest attention are the “paved terraces” of Pljesevica manifested by the repeating lenses of sandstone separated by about a meter of claystones and mudstones (classified as Tlm on the map and general description in Section 4.1). The exposed area has been previously covered by about 40-60cm of soil overburden, however, there are apparently two soil horizons – one recent, and one formed only 5-6cm above the sediment layers, obviously some kind of a paleosurface horizon with a possible carbon layer (burning?). Now exposed (by digging) sandstone layers exhibit numerous cracks roughly a centimeter wide and oriented in a ENE direction. Currently three such terraces are exposed, one claystone and two sandstone terraces; the lowermost sandstone terrace has particularly well developed ripplemarks that extend over the entire surface and can be traced across the cracks, suggesting that the cracks were formed later (Figure 6a).

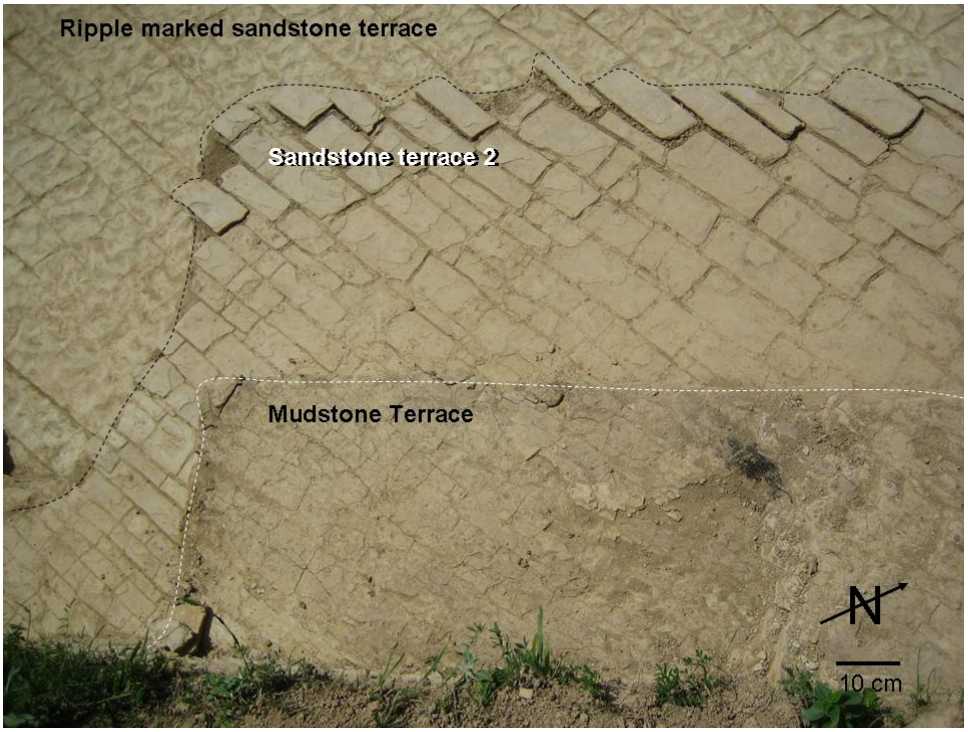


Figure 6a – Sedimentary terraces exhibiting identical crack propagation

This orientation of cracks would be congruent with the overall stress direction and if the cracks have formed as orthogonal shear-stress to the principal axis of stress. Venturing just a bit further south of the are and up the section from the exposed terraces, another structural feature is noted which further reinforces this observation (Figure 6b).

Figure 6b – Apparent plastic deformation of the sediment in the similar orientation as crack propagation suggesting that the same (or repeated episode) might have been responsible for both.

It is evident that some of the secondary structural features associated with the basin deformation are more pronounced at Pljesevica and present a good locality for later studies of overall stress accommodation in the area. Unfortunately, the presence of a great number of visitors (in the lower strata) and mines/UXOs (in the upper strata) prevented detailed measurement and analysis of the Pljesevica region in this field campaign.

7.0 Tunel System

The tunnel system to which an entrance is located approximately 2.8 km NNW from the crest of Visocica (at the village of Ravne) was not targeted in the remote sensing campaign (because it was out of the general target area). The data available of over the area consists mainly of optical data insufficient to offer any penetrative ability or indications of the tunnel direction or any associated geospatial anomalies. This report only makes a cursory note of the tunnel because some elements noted there might be of significance to understanding the overall geology of the area.

The system is obviously artificial (Figure 7a) and built with a purpose because the strike of the tunnel follows the apparent sandstone/conglomerate contact in the general direction extending towards Visocica, the walls and ceilings are rectangularly shapped in places, and some of the critical junction areas appear to have been at one point reinforced by layered sandstone blocks. In addition every 15 m there are indications of ventilation shafts, which may be leading to the surface, which (before some “stabilization work” took place) allowed for the proper air circulation (measured by the mine safety experts in April of 2006). In April and June of 2006, the total length of the tunnel passable was 342 m (note: by passable it also means crawling).

Figure 7a – Flattened ceilings and constructed walls in the tunnel. Note that the tunnel is roughly following the contact between the sandstone and conglomerate.

The tunnel entrance is reinforced by the same type of coarse sandstone noted on the “access plateau” of Visoscica and several blocks have also been noted inside of the tunnel. Unlike the blocks on the access plateau, these sandstone blocks appear to have been cut and worked with a purpose of reinforcing entrances and divergent tunnels. The entrance to the tunnel appears to follow a contact of cemented conglomeratic sediments, but about 30 meters into the tunnel, the cohesivity of matrix breaks up and the majority of the tunnel is cut through unsorted alluvial material.

In the areas where the water is seeping into the tunnel and the ceilings or walls are more resistant, substantial concentrations of stalactites are noted (Figure 7b). In the areas where ththe tunnel portions are not accessible the stalactites are better preserved and much longer, but in the majority of the tunnel, the stalactites have been broken off at the top. Majority of the smaller stalactites have a diameter of about 2cm, while some of the larger ones (in the side tunnels) have a diameter of about 5cm.

Considering relatively lower concentration of carbonate in the immediate area, lower level of carbonate solution by the hard water and generally available numbers for stalactite growth in the Bijambarska cave (some 30km away) it can be surmised that the growth of stalactite is about 0.133mm in Y-axis, or 0.089mm in X-axis. According to these numbers, we can speculate that the stalactite about 3cm long would be at least 300 years old, suggesting that these tunnels may have existed for a considerable period of time. Again, Bijambarska Cave is in a different setting and may not represent the best analogue, but is the only information on carbonate growth available at the time of this report's writing.

Figure 7b – Some of the broken stalactites in the tunnel

8.0 Correlation with Remote Sensing

Geospatial anomalies noted in the area were described in the earlier report by Smailbegovic in January of 2006. This report is a ground-follow-up intended to briefly revisit and cross-correlate some of those observations. Considering that the majority of observed anomalies are best pronounced at the locality labeled Visocica, the report will focus on comparing/contrasting the observations there. The most pronounced elements are a) radar topography, b) textural features c) thermal properties of the area and are listed below in this brief reminder to the previous report.

8.1 Radar Topography and Imaging

Combined information from the numerous radar systems using Synthetic Apperture Radar (SAR) technology in frequencies L, C and X (topographic component) and polarizations Horizontal-Horizontal and Vertical-Horizontal indicates presence of clearly defined edges and triangular sides of Visocica (Figure 8a). These features remain apparent even under various false illumination directions minimizing the possibility of artifacts, illumination and perspective illusions.

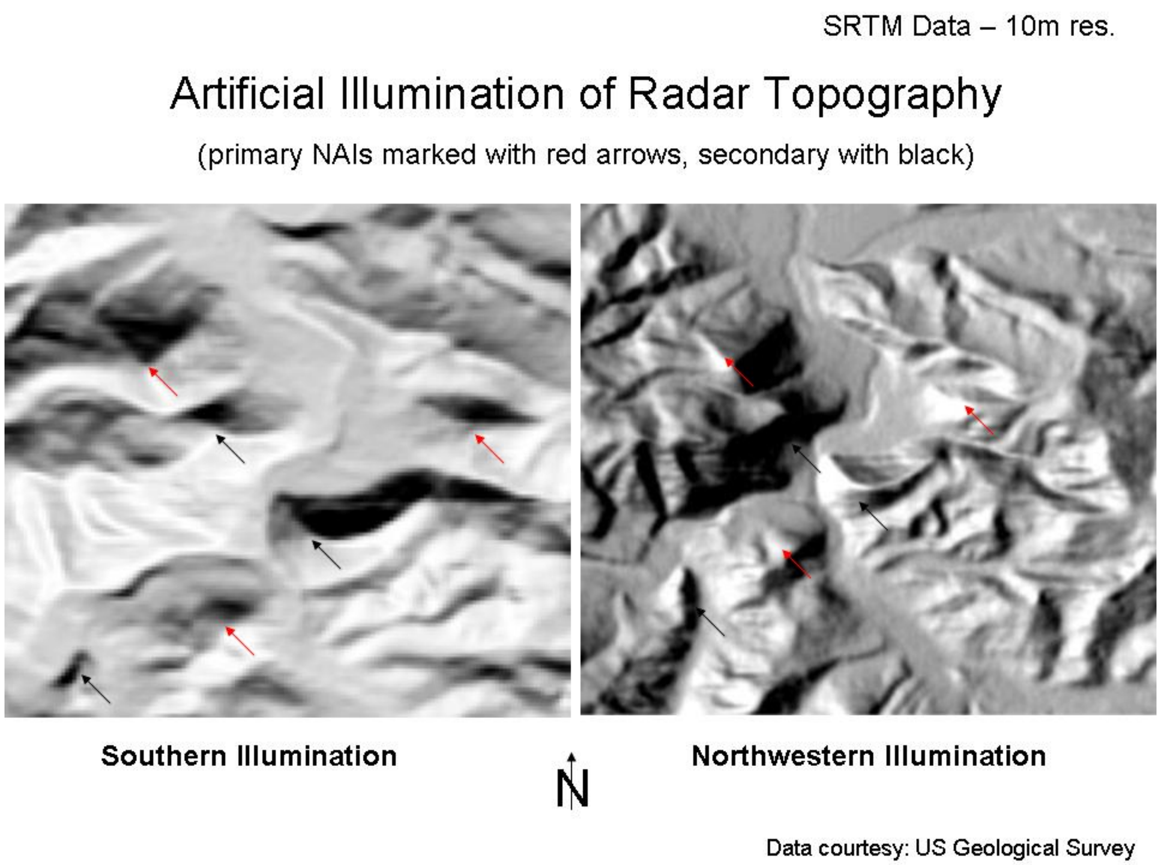
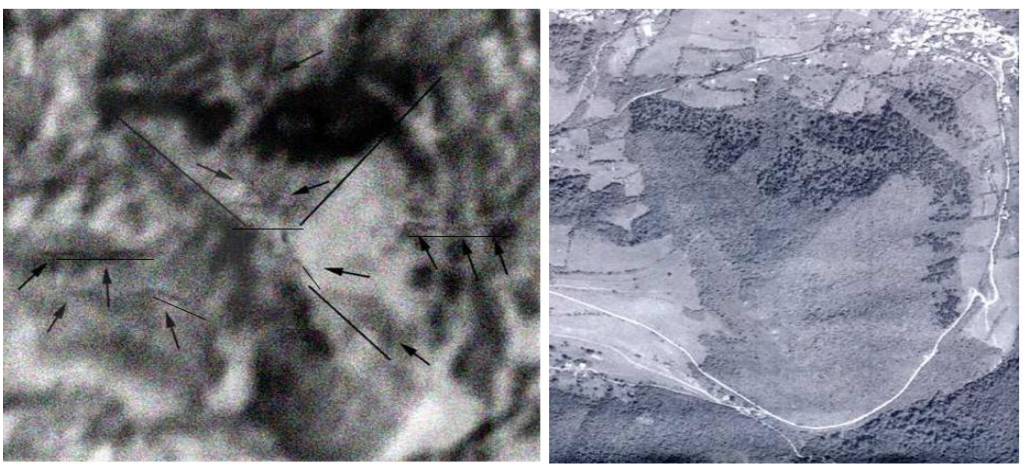


Figure 8a – Artificially illuminated radar topography

Further analysis and filtering of the data shows the possible existence of surface or near-surface lineaments, apparent on all sides of Visoscica. These lineaments are expressed as the attenuation of the signal in the reflected radar beam and suggest that there is an element of dispersion (or even absorption) of radar beams due to an existence of some linear object or feature (Figure 8b).

On the ground, these occurrences are manifested as the areas of slope break and flattening (northern side), ancient moats (top), terraces on the plateau (west) and channels (east). Preserved topography and relatively smooth reflectivity of the radar data (decreased pixilation) on the northern side of Visocica may be possibly attributed to the presence of relatively flat and polished conglomerate layers (pseudo-specular reflection?).

Anomalni lineamenti oznaceni strelicama, podzemne strukture ili artefakti



Kompozit RADAR C-frekevencije (16m)
(RADRSAT-1 + SPOT-C)

Opticki snimak 3m SPOT Satelit

Data courtesy: ESA

Figure 8b – combined RADAR data (left) and optical 3m resolution SPOT image.

8.2 Optical Data

The analyzed data include various spaceborne and airborne images over the area collected at high resolution (18cm – 1m). On these images it is relatively simple to note the edges and textures of the objects. Linear structures, textural and shape differences are often related to changes in geologic continuity, but also possible anthropogenic effects.

Verification (Figure 8c) of the data suggests that the defensive character of Visocica is concentrated to the top or the upper third of the hill, where the majority of the walls, reinforcements, moats and external terraces/walls are located. The cross-over into the 2nd third is manifested by a change of texture into a much flatter and subdued appearance, and apparent topographic break. On the east side, several channel like structures and terraces are also are apparent (field data indicates that there are some elements of a wall or topographic break) and they to appear to follow the contours to the north-side fairly steadily.

The eroded southern side is clearly visible as relatively young and still forming colluvial erosive fan. There are no apparent drainage channels formed on its surface yet suggesting that it is still very young structure and in the process of formation.

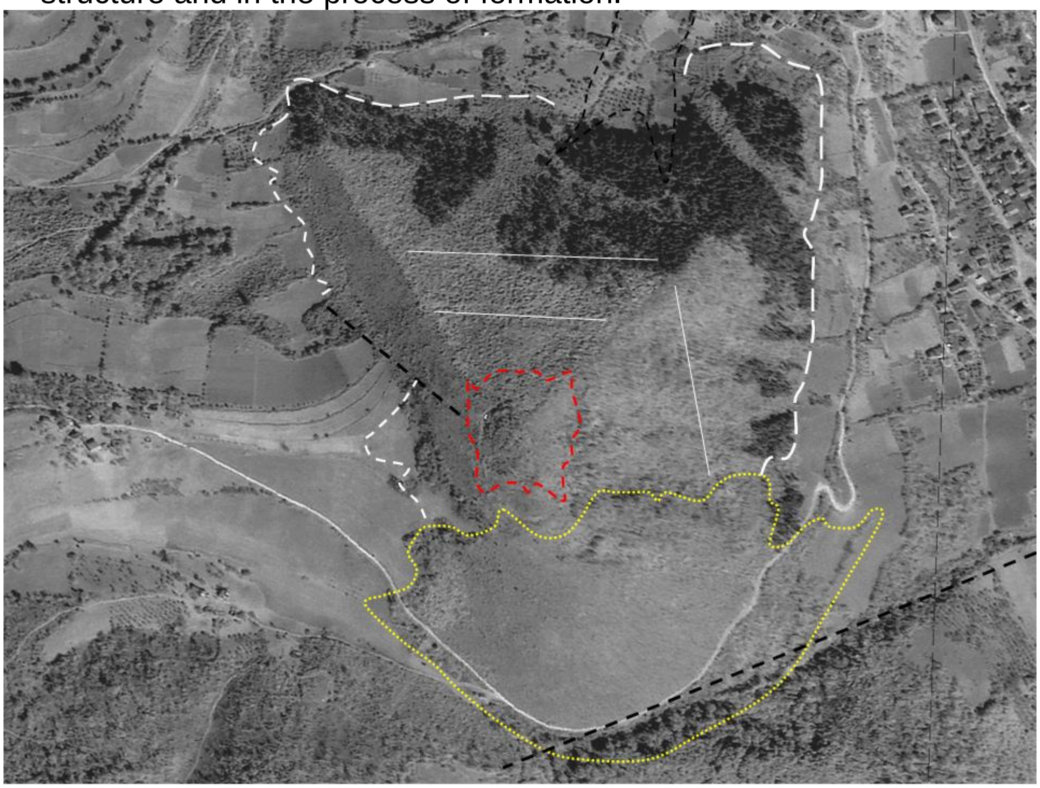


Figure 8c – Elements of recognition noted on the 1m optical imagery. The domain of medieval town is delineated in RED, the young colluvial fan is delineated in YELLOW, possible fault areas in BLACK DASHED LINES, terraces (topo breaks) in WHITE DOTS and contact between conglomerate and sandstone in WHITE DASHED LINE.

The changeover from conglomerate to sandstone is also evident because there is a further "softening" of the texture and better "adherence" of vegetation to the sandstone. It appears that the sandstone is giving a better base for the herbaceous growth rather than conglomerate, likely due to its coarse and impervious structure.

8.3 Thermal Inertia Data

The field data indicate that Visocica (as well as Pljesevica, Krstac and Bucki Gaj, last two examined only with a cursory attention) are all comprised from the materials of lesser density, with elements of porosity and internal cavities (note cavities shown in conglomerates on Figure 5c). Considering that the surrounding area is comprised of denser sediments and/or carbonates, Visocica (and others) are therefore far more conducive to thermal energy loss than the surrounding area. On a 60m thermal image, registered to a 1m high resolution base it is evident that the areas of low thermal inertia loosely correspond with the contact between the conglomerate and dense sandstone (Figure 8d).

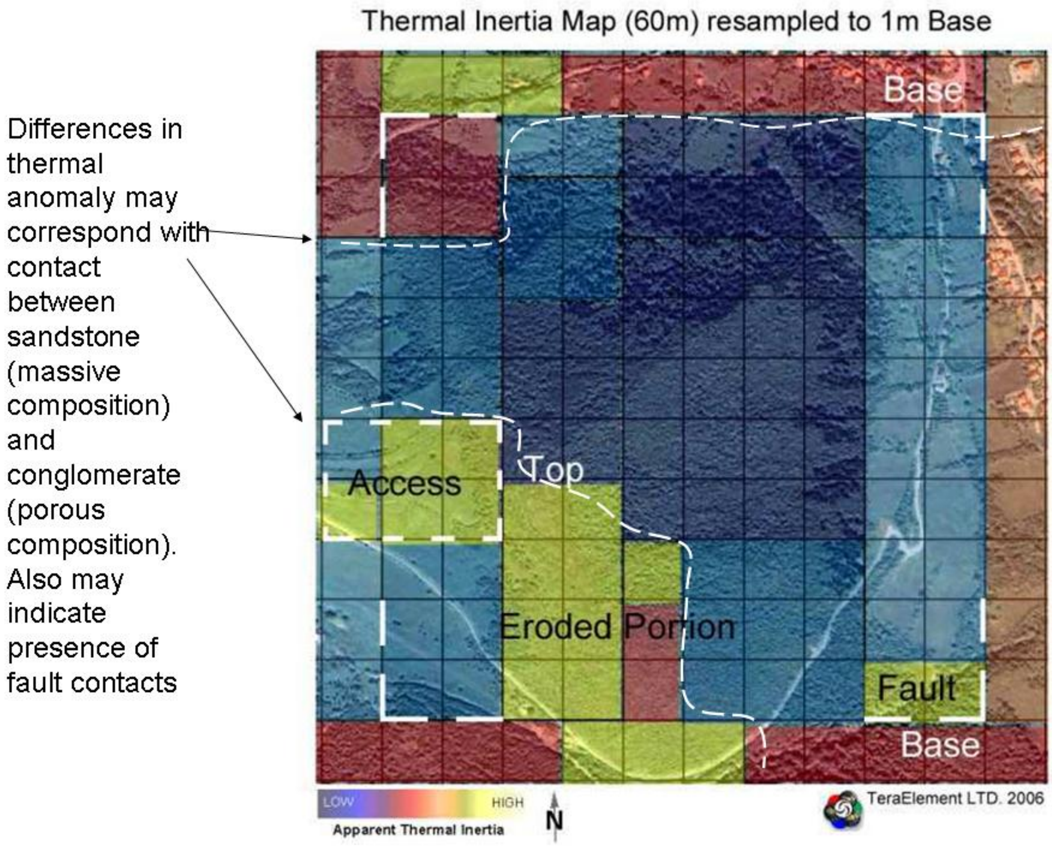


Figure 8d – Thermal inertia differences, note that the areas of low inertia correspond with conglomerate areas on Visocica.

9.0 Discussion

This brief field report and an addendum to an earlier remote sensing analysis report is intended to point out some of the important element that MUST be taken into account before any archaeological interpretations. The report suggests that the overall target area is complex, containing various elements of deposition, erosion, faulting and folding in a Neogene sedimentary basin. There are some elements of anthropogenic contribution to the overall geomorphology and current state of the area, but it is absolutely necessary to discern the natural factors first.

Considering the locality Visocica, both remote sensing and field data suggest that it represents relatively autonomous unit with clearly defined base and edges, comprised of conglomeratic sediments. It is difficult to determine whether the conglomerates have any elements of later anthropogenic shaping. What remains peculiar is their overall shape in places, changes in dip, relatively flat and polished nature and presence of well defined edges. Undoubtedly all of the observed structures and localities have sustained considerable degree of erosion and have been subjected to various tectonic deformations up to the present day. These elements pose additional problems in understanding the area and separating natural from artificial (if any).

What is evident from both remotely sensed and field data is the following:

- Texture and shape – flat texture and even shape of the northern and western sides of Visocica corresponds with the presence of dipping, flat conglomerate blocks.
- Radar lineraments correspond with the slope-break areas on the northern side with massive sandstone near-surface concentrations and water-ponding areas near the fault zones.
- Thermal difference (rapid cooling) corresponds with the conglomerate areas, which exhibit lesser density materials and presence of inter-block cavities.Rapid change from one thermal regimen to another is indicative of contact between the sandstone and conglomerate.
- Large number of topographic lineaments appear to propagate along the lines of orthogonal shear-stress related to the obsrerved faulting episodes
- Drainage is consistent with very young structures (primary order consistent with the pseudo-artificial origin or recent neogene uplifts)

10.0 Conclusion

It is evident that both Visocica and Pljesevica represent naturally occurring hills created as a result of uplift, deformation and erosion of Neogene sediments in Zenica-Sarajevo Basin. Their natural position and shape makes them ideal areas for later fortifications and there are apparent elements of human activity on/around them going back to the Neolitic times. It is doubtful that they represent ancient colossal stone structures with a sacral purpose in mind, but rather apt and inventive usage and reinforcement of existing (and dynamic) geomorphologic characteristics to attain the maximum effect.

NOTE: The author and his collaborators are not experts about the local or regional geologic conditions and this report should be considered a field-interpretive report to the best of author's abilities. It is a working version offered to other geologists to give them insight and understanding of what may be observed in the field.