APPLICATION OF GIS IN THE SPECIAL ZONE OF INTEREST "GUMNISHTË" - KOSOVO

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ABSTRACT

Most of the geological data in our country that are in analog form should be digitalized, therefore, this paper aims to present a necessary and urgent opportunity to various data contained as analog data from the past to be converted into digital data which then will offer various opportunities to work with them.
Through this paper is intended to make a general statement of GIS applications to demonstrate the role of different applications of Geographic Information Systems (GIS) in the field of geology and mining as well as show the significant role that GIS plays as an opportunity to data integration and geo-spacedata manipulation tool.

Keywords: GIS, ArcGIS, Shape, area, geodatabase, data, layer.

1. INTRODUCTION

One of the biggest challenges faced by geologists and earth scientists is assimilation, distribution, and the management of continually increasing quantity of digital information. To solve these challenging problems, we have to change the way information and datacan be stored, used and distributed. One of the most promising systems used by earth scientists is the Geographic Information System (GIS). GIS is an organized collection of hardware, software, and data designed to store, manipulate, analyze, and display information for decision making and accurate analysis of these spatial data. One of the misconceptions about GIS is that it is only a map-making tool. In fact, GIS does much more than simply making maps. It enables a user to analyze, study, seek and optimize a database for a particular purpose. These are simple tasks that can be completed within few seconds.

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GIS is a fundamental tool that if used properly, can provide effective support for spatial planning and decision-making, because the geographic component of the problem is determining when the sustainable development is in question. Therefore, geospatial technologies should be leading the technical implementation of open platforms and integrated information analysis, problem solving, group planning and decision-making.

2. ZONE OF STUDY

Mines and Minerals Law no. 03 / L-163, adopted by the Assembly of Kosovo in 2010, provides for the government the appointment of particular zones of interest, where the energetic mineral deposits are found or other metallic minerals, industrial and valued stones, semi-valued or in those quantities as well as with those characteristics. These areas are expected that will attract the interest of some exploration and mining companies with experience and good financial resources. Areaof Gumnishte, already announced a special interest zone. The zone of interest "Gumnishte" lies in the territory of the municipalities of Mitrovica and Vushtrri and borders to those coordinates in KOSOVAREF01. Altitude 600 - 1300 m and the surface area is 29,172 km² . In 2007, in this area drilling has been done from Drilling Department of Stanterg Mine whose elements are presented in Table 2. It is thought that the institutions of Kosovo in accordance with the laws of the country will give this area for exploration to potential interested foreign companies.

Table 1. Determinative coordinates of the Zone

Coordinates of Zone		
Nr	Y	X
1	7495519	4751307
2	7491495	4751242
3	7491565	4753014
4	7498266	4753013
5	7498166	4756813
6	7497566	4758513
7	7500559	4758747
8	7500564	4751390

Table 2. Collar data of drilling

Elements of drilling					
Nr	Y	X	Z	Azimuth of Drilling	Decrease angle
1	7500388	4754783	1240	310°	-44

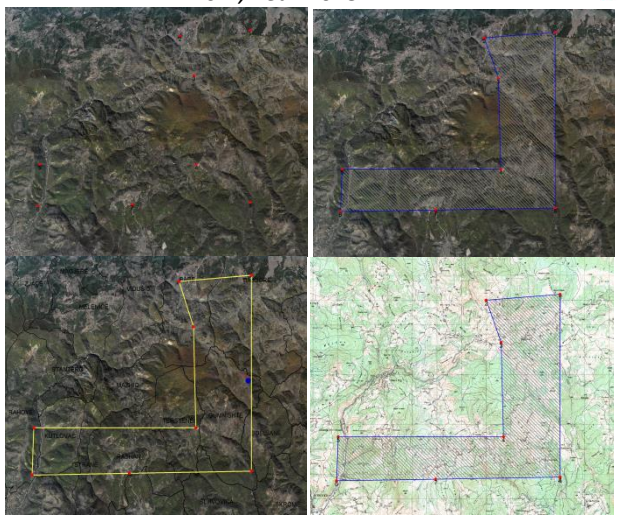


Figure 1. Map of the zone of interest "Gumnishtë"

Settlements:The area is characterized by the presence of several villages and lies on a small distance from the town of Mitrovica.
Road infrastructure:The area lies near the main road paved Prishtina-Mitrovica. Small streets paved with sand and gravel across the area of interest. Nearby is the nearest railway station. Village is connected with asphalt road with Vushtrri town.
Power supply:The electricity conductors extends 1 to 13 km in W NE (outside the area of interest).

3. DEFINITION OF COORDINATE SYSTEM

Coordinate system is one of the key elements of each map. It shows what kind of mathematical model is used for the presentation of geospatial mapping elements. It should be emphasized that all introduction data that are used for mapping are obtained from the responsible relevant state institutions and are parto of the state coordinate system "KOSOVAREF01". It follows that for developing of the new map the same system of coordinates should be used. The coordinate system "KOSOVAREF01" has the parameters depicted in Figure 2. By using options offered by ArcGIS, we have defined the coordinate system of the work window in ArcGIS according to the abovementioned parameters to continue with other activities in accordance with the aim of the paper.

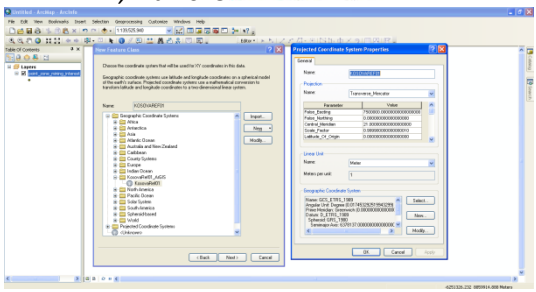


Figure 2. Definition of coordinate sistem

4. MAP GEOREFERENCING

One of the processes on the way on digitizing mapping is called geo-referencing. Scanned Maps called from whatever software for further use should be geo-referenced. ArcGIS software contains many options to work with geospatial data among which also geo-referencing is enabled. ArcGIS software enables geo-referencing map with just a few clicks needed. After we browse the scanned map in JPG format we continued geo-referencing by utilizing tools from the geo-referencing toolbar. In order to save forever the transformed scanned map we use the option "Update Geo-referencing", which means that the original version of the map is already geo-referenced. Figure 3 presents a caught moment during geo-referencing the map in ArcGIS.

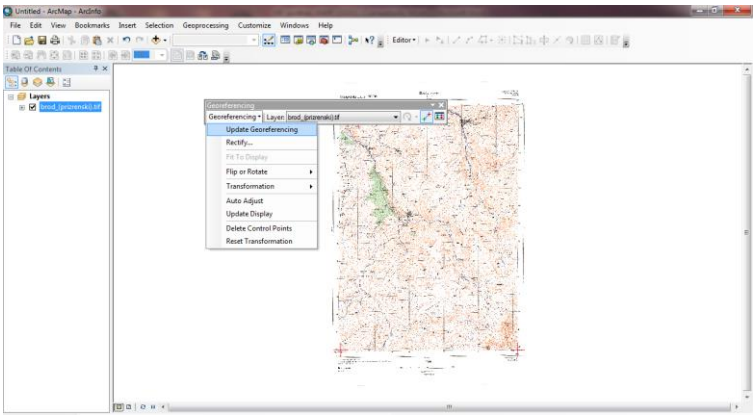


Figure 3. Map Georeferencing

5. GEODATABASE

5.1. Description of the Geodatabase

A database is any information collected and organized into groups. This database is created from tables, questionnaires, forms, pages, reports etc. The basic unit of the database is a table, which stores the data in an organized manner. Geodatabase is a structure which enables the registration and management of geographic information in a RDBMS. An RDBMS can be Oracle, MySQL, PostgreSQL, etc. GIS is a system that allows a database not to be built only as a conventional geodatabase, simply for maintaining records and their relations, but analyze, present and convert the notes recorded in the tables of the database in dynamic maps. Geodatabase (acronym of Geographic Data Base) is a physical storage of geographic information such as spatial information, attributes, metadata and relationships, which are inside the RDBMS (Relational Database Management System).
Geo data base model includes object-oriented model for defining the characteristics, behaviors and relations vector data and the strengthening of sanctions and integration of data provided by the system. Also, the geodatabase of this paper will be created in accordance with this that explained above.

5.2. Data format

Geographical data in GIS require a specific format for data storage as they comprise of the geographic form as well as descriptive data. The most common model for GIS data storing is the vector, which uses points, lines and polygonsto present the mapping objects. The most widely used format in GIS applications is "shapefile", which is the standard format in ArcGIS, QuantumGIS, KosmoGIS and many other GIS applications. This format enables the storage of vector data in anappropriate form for GIS applications. "Shapefile" consists of at least three separate files (this is the minimum necessary for a shapefile to be considered correct, depending on the actions taken by these data the number of files that form a shapefile is often greater than three) that must be stored in the same directory (folder); otherwise, the GIS application will not be able to recognize these files as part of a "shapefile".

Most common files that make up a "shapefile" are:
.shp - which preserves the geometry of objects (point, line, and polygon)

.dbf - database file in which information of attributes from objects is stored.
.shx - file which will store the objects geometry indexes.
.prj - the file where the information is stored on the coordinate system data in "shapefile".
.sbn and .sbx - file where indexes of geographical spatial objects are stored.
To realize this paper we have chosen the data format respectively layers that will be presented as shown in the table below, we estimate that it is the most appropriate format to achieve the aim of the paper.

Table 3. Data format

	Format for raster and vector data						
1	Features for pints	Shape and excel	Attributes	Y, X, Z	Desriptions of points	Code	ID
2	Features for lines	Shape	Attributes	Length (m)	Desriptions of lines	Type of lines	ID
3	Features for areas	Shape	Attributes	Areas (m^2)	Name of zone	Type of areas	ID

5.3. Creation of geodatabase

Designing the geodatabase through ArcGIS enables the geodatabase to be valid and stable, a detailed design of each of the fields-attributes and type, the geospatial scope of each feature, the list of code per each attribute, categorizing based on codes, creating special tables with textual data, creating the link between tables with textual and spatial data, integrating the raster format in the server. In designing the geodatabase, there will be options to design the features, history, and to archive them. This is very important and needed for the future developments and also calculations of different statistics. ESRI has advanced new geographic model called geodatabase which uses Microsoft Access files to store many tables, shape files and raster images. Initially, we created geodatabase for the points to continue with the database for lines and surfaces which we have enriched with the necessary attributes for them such as; name, type, code, coordinates,length, area, etc. The following figures represent the creation of thematic layers for the zone of interest "Gumnishtë".

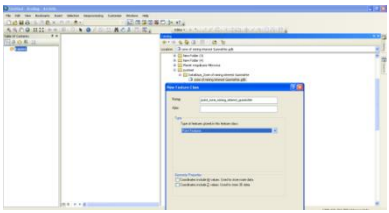


Figure 4. Creating shapefile

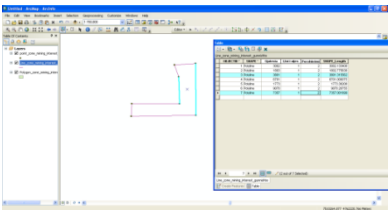


Figure 5. Geodatabase lines

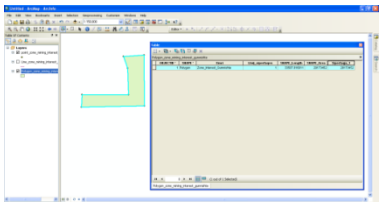


Figure 6. Zone Geodatabase

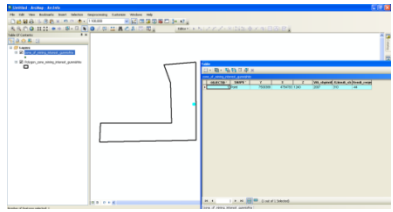
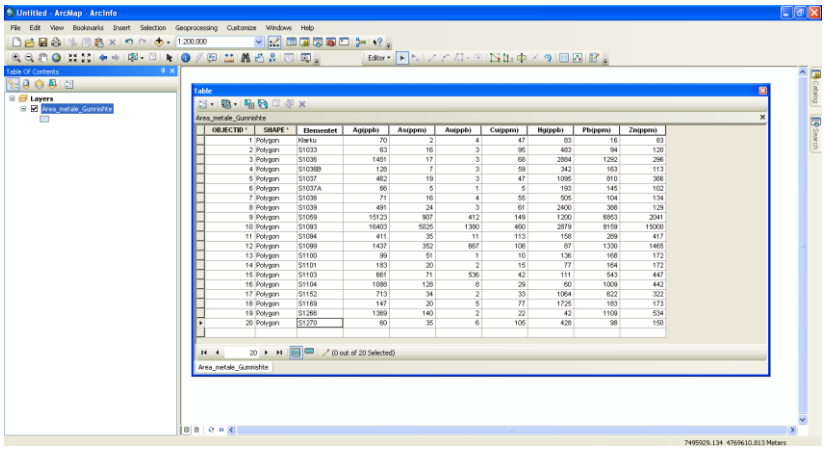


Figure7. Geodatabase of geological drilling

Figure 8. shows the database with metal values which are benefited as a result of samples taken during different drillings. It seems that no matter the volume of data, GIS enables to enter this data, and if necessary to manipulate the content in order to benefit different results depending on the requirements set forth.



OBJECTID	SHAPE	Elementet	Ag(ppb)	As(ppm)	Au(ppb)	Cu(ppm)	Hg(ppb)	Pb(ppm)	Zn(ppm)
1	Polygon	Kliartu	70	2	4	47	83	16	83
2	Polygon	S1033	83	16	3	95	483	94	128
3	Polygon	S1036	1451	17	3	68	2884	1292	296
4	Polygon	S1036B	128	7	3	59	342	163	113
5	Polygon	S1037	482	19	3	47	1095	810	386
6	Polygon	S1037A	66	5	1	5	193	145	102
7	Polygon	S1038	71	16	4	55	505	104	134
8	Polygon	S1039	491	24	3	61	2400	388	129
9	Polygon	S1059	15123	907	412	149	1200	6953	2041
10	Polygon	S1093	16403	5825	1390	460	2879	8159	15000
11	Polygon	S1094	411	35	11	113	158	289	417
12	Polygon	S1099	1437	352	667	108	67	1330	1465
13	Polygon	S1100	99	51	1	10	136	168	172
14	Polygon	S1101	183	20	2	15	77	164	172
15	Polygon	S1103	661	71	536	42	111	543	447
16	Polygon	S1104	1088	128	8	29	60	1009	442
17	Polygon	S1152	713	34	2	33	1064	622	322
18	Polygon	S1169	147	20	5	77	1725	183	173
19	Polygon	S1266	1389	140	2	22	42	1109	534
20	Polygon	S1270	90	35	6	105	426	98	150

Figure 8. Database with content of minerals

6. CREATING OF DIGITAL MAPPING

The digital map is created using data presented as follows:

- Coordinates defining the area
- Connecting lines between the coordinates defining the area
- Surface area
- Geological Drilling

Since the data we have already is in the appropriate form so that they can easily change shape, can be changed to be updated in the text, in graphics and different maps could be created depending on the defined requirements. The figure shows the digital maps created with the above mentioned layers.

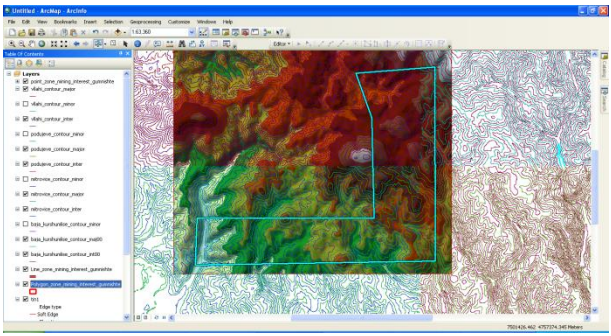


Figure 9. The digital map of the zone

7. ROLE OF GIS IN ESTABLISHING DTM AND SPATIAL ANALYSIS

GIS also allows us to create digital terrain model with just a few clicks, as we used points needed to create the DTM on the working page of ArcGIS digital terrain model of the zone of interest "Gumnishtë" will look like in the Figures shown below, the DTM allows engineers who will do fieldwork to be notified from their office about the terrain and relief they are going to visit.

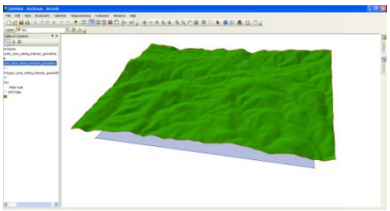


Figure 10. Creating DTM

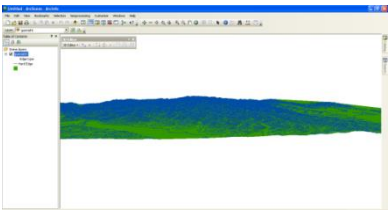


Figure 11. 3 D Digital Terrain Model

GIS also allows for different spatial analysis but we have to consider the logic analysis so we do it in the right way. In our paper we have demonstrated through ArcGIS the geological drilling done in the "Gumnishtë" zone, whether it is located within the area of interest or not?! The answers for this question we see on the next figure. This is one of the simplest spatial analyses that can be done through GIS.

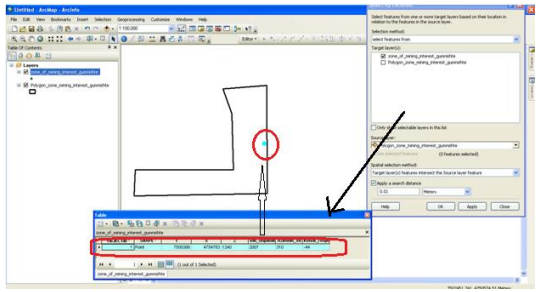


Figura 12. Spatial analyses

8. PREPARATION OF MAP FOR PRINT

Various data generated in digital form are sometimes necessary to be printed for various reasons, one of which may be that printed maps serve geologists for field orientation, or even to extract various geological elements from printed maps. ArcGIS also has numerous opportunities to create the maps in the most suitable printing form such as: presentation of coordinates, legend, northern direction, graphic and numerical scale, and any other writings on the map, etc. Once the map is assigned the elements that would need when printed, ArcGIS enables mapping conversion in another format that is suitable for printing such as: JPEG, PDF, etc. The map that you see in Figure 12 shows an example of this kind of mapping form for printing and is from the mining zone of interest "Gumnishte".

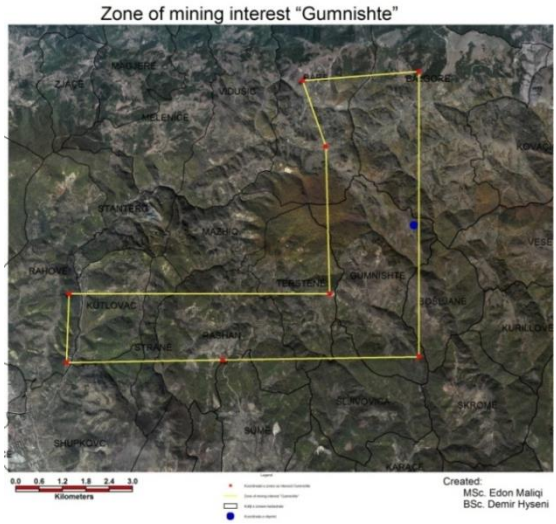


Figure 13. Preparing the map for printing

9. CONCLUSIONS AND RECOMMENDATIONS

The foundation of any GIS database is "Every object on the earth can be geo- referenced". Geo-referencing is the position of a layer or cover in space, defined by a reference coordinate system.
GIS is a convenient tool and helps geo engineers to develop plans for management strategies that could be sustainable both locally and globally.
One of the biggest benefits of using GIS is that allows for numerical data / textual and geographic to work with one another. GIS enables all spatial data and non-spatial for mines to be stored on a unique database and enables easy manipulation with this data.
GIS also allows the extraction of different information about this zone of interest and at different times. Knowing the different formats of data is one of the attributes that makes GIS to be a leader in this field. Applications of GIS shows, that is suitable for creating different geological layers, which can be enriched with different attribute that we can make different analysis. GIS allows easy management of various data and also to manage the large volume of data. Creating DTM through GIS enables us to create an image of the terrain which we will investigate.
We hope that this paper will be used as an example by the relevant institutions and various experts and to continue with such work in the future and make data entry of geo-spatial data for all nine zones of interest that exist in our country.

Acknowledgement
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