RESERVE ESTIMATION FOR URANIUM DEPOSITS

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Approximate Correlation of Terms used in Major Resources Classifications (U-2005)

<table>
<tr><th colspan="3">Identified Resources</th><th colspan="3">Undiscovered Resources</th></tr>
<tr><td>NEA/
IAEA</td><td>Reasonably
Assured</td><td>Inferred</td><td>Progno
sticated</td><td colspan="2">Speculative</td></tr>
<tr><td rowspan="2">Austra-
lia</td><td colspan="2">Demonstrated</td><td rowspan="2">Inferred</td><td colspan="2" rowspan="2">Undiscovered</td></tr>
<tr><td>Measured</td><td>Indic-
ated</td></tr>
<tr><td>Canada</td><td>Measured</td><td>Indic-
ated</td><td>Inferred</td><td>Prognos
ticated</td><td>Speculative</td></tr>
<tr><td>USA</td><td>Reasonably
Assured</td><td colspan="2">Estimated
Additional</td><td></td><td>Speculative</td></tr>
<tr><td>Russian</td><td>A + B</td><td>C1</td><td>C2</td><td>P1</td><td>P2 – P3</td></tr>
</table>

Reasonably Assured Resources (R. A. R)
مصادر معقولة التأكد (م م ت)

Known mineral deposit of delineated size, grade & configuration (3D) as: quantities/cost/processing & technology). Have high existence

Inferred Resources
(مصادر مقدرة إضافيا)

Based on the direct geologic evidences in extension of well-exposed deposits or in which geological continuity has been established, but its specific data are not enough to be RAR.

Prognosticated Resources

The evidence of this type is mainly indirect and which are believed to exist in well defined geological trends or areas of mineralization with known deposits.

They are expressed in terms of uranium in mineable ore

Speculative Resources (U-2005)
المصـادر التخمينيـة (م ت)

Based on indirect evidences & geologic explorations.

The existence and size is speculative (In situ quantities)

Documentation
(Records and Mapping system)

It is important that every organization operating in the field of mining should have effective system on collecting and recording data used to evaluate reserves of any mineral deposits. There must be a daily report, weekly and monthly progress reports in the working place. Further, there must be a selected system for numbering samples linked to the site, the mine and cross-cuts. Standards sizes for drawing maps of the reports Digitizing of these documents is essential.

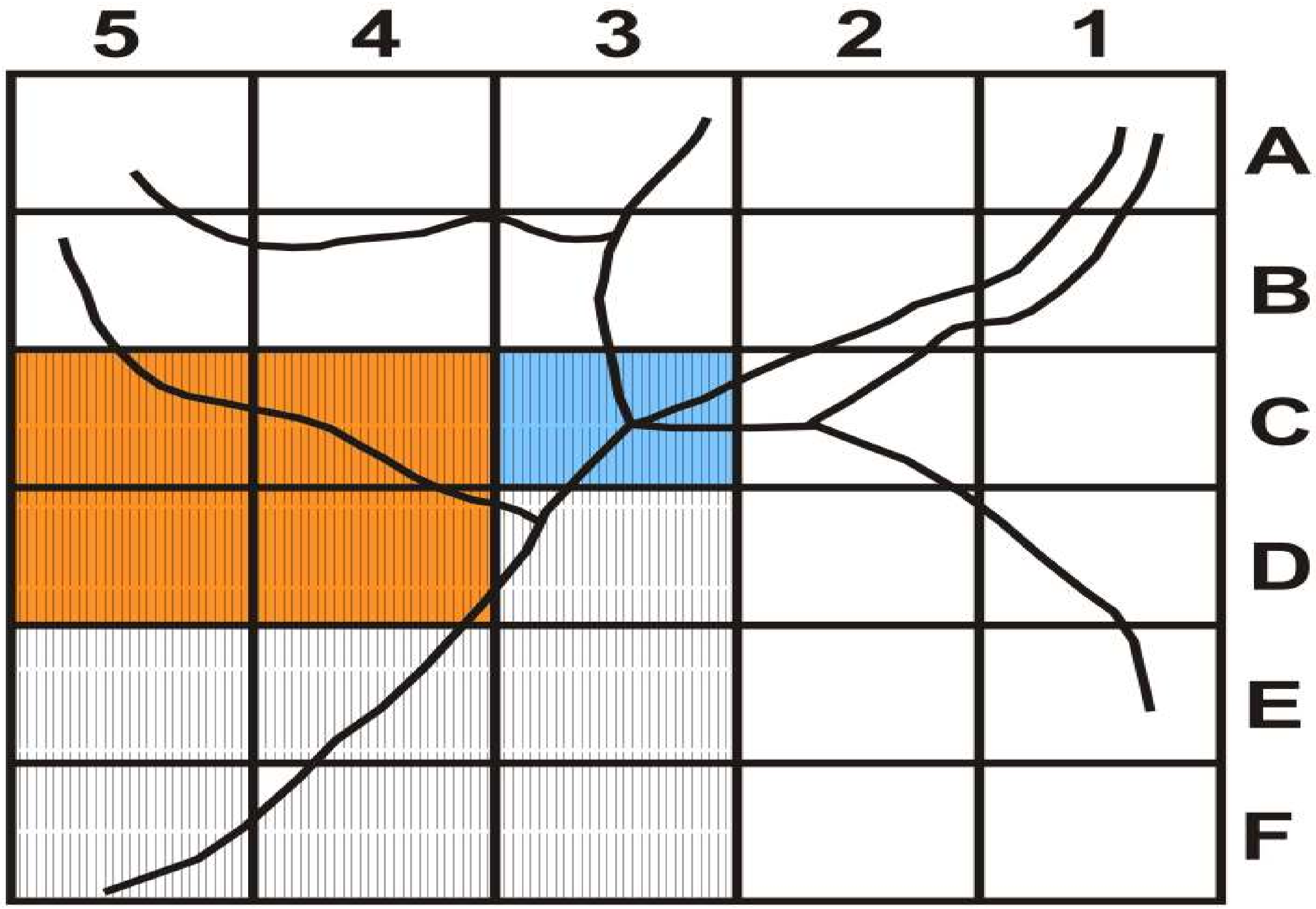


Fig. 1 Area map (A-F/1-5) on 1:5000 scale showing Map for C-F/3-5 on scale 1:1000 ,Map for C-D/4-5 on scale 1:500 and Map for C/3 on scale 1:250

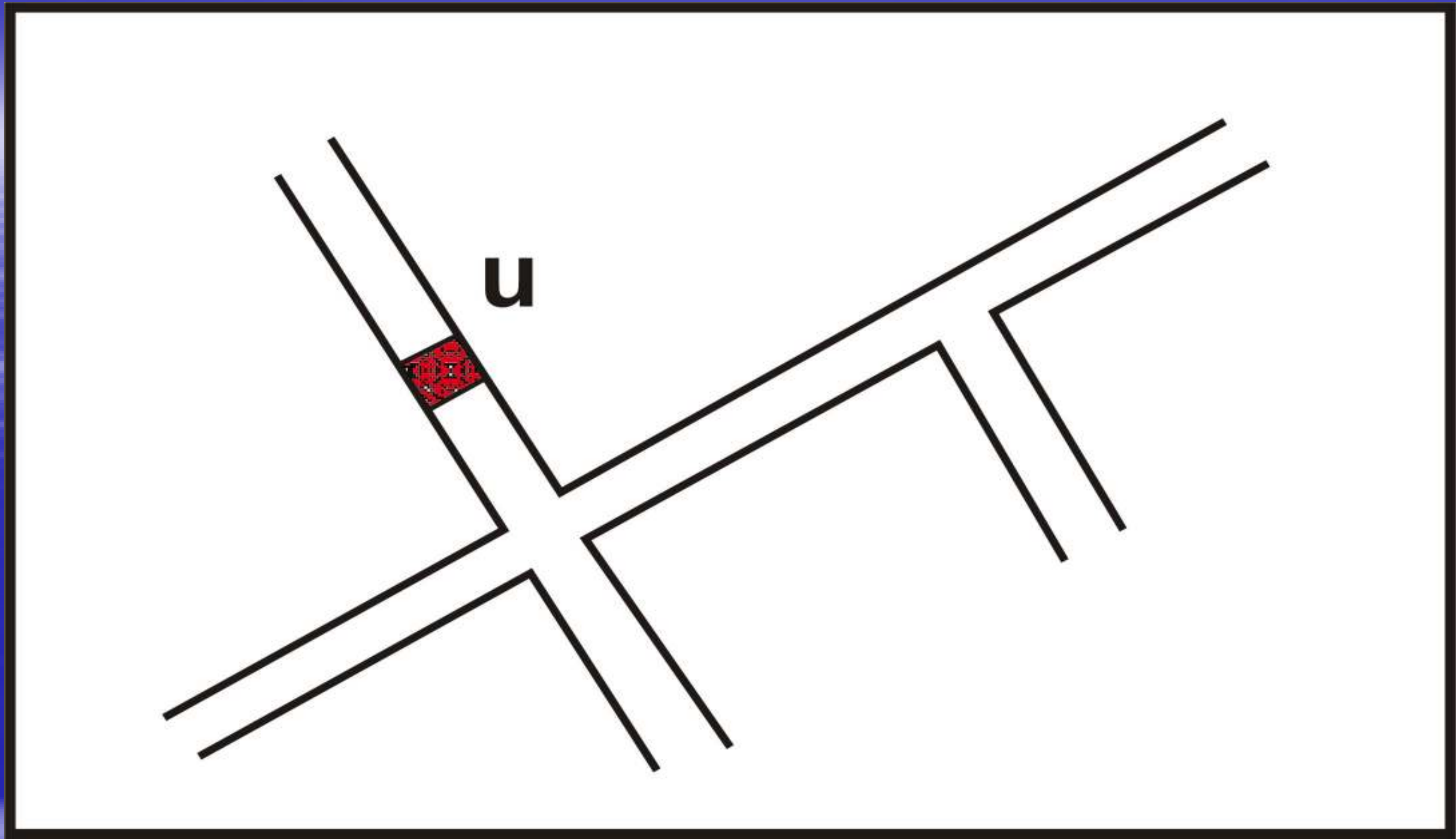


Fig. 2. Mine map for the mine C/3/1 (level 1)

Scale 1: 250

Sampling

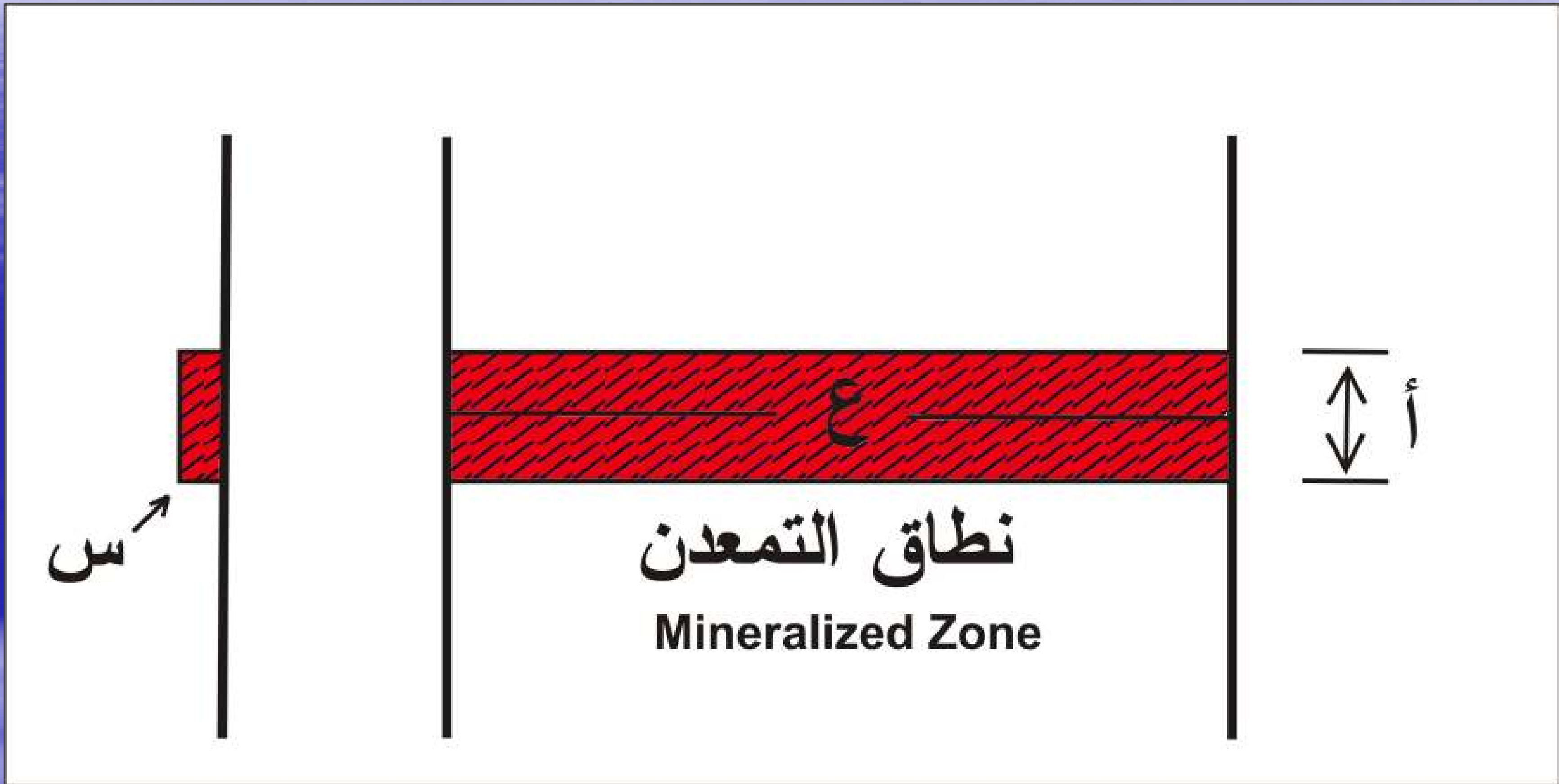


Fig. 3: Sample position in the mineralized zone

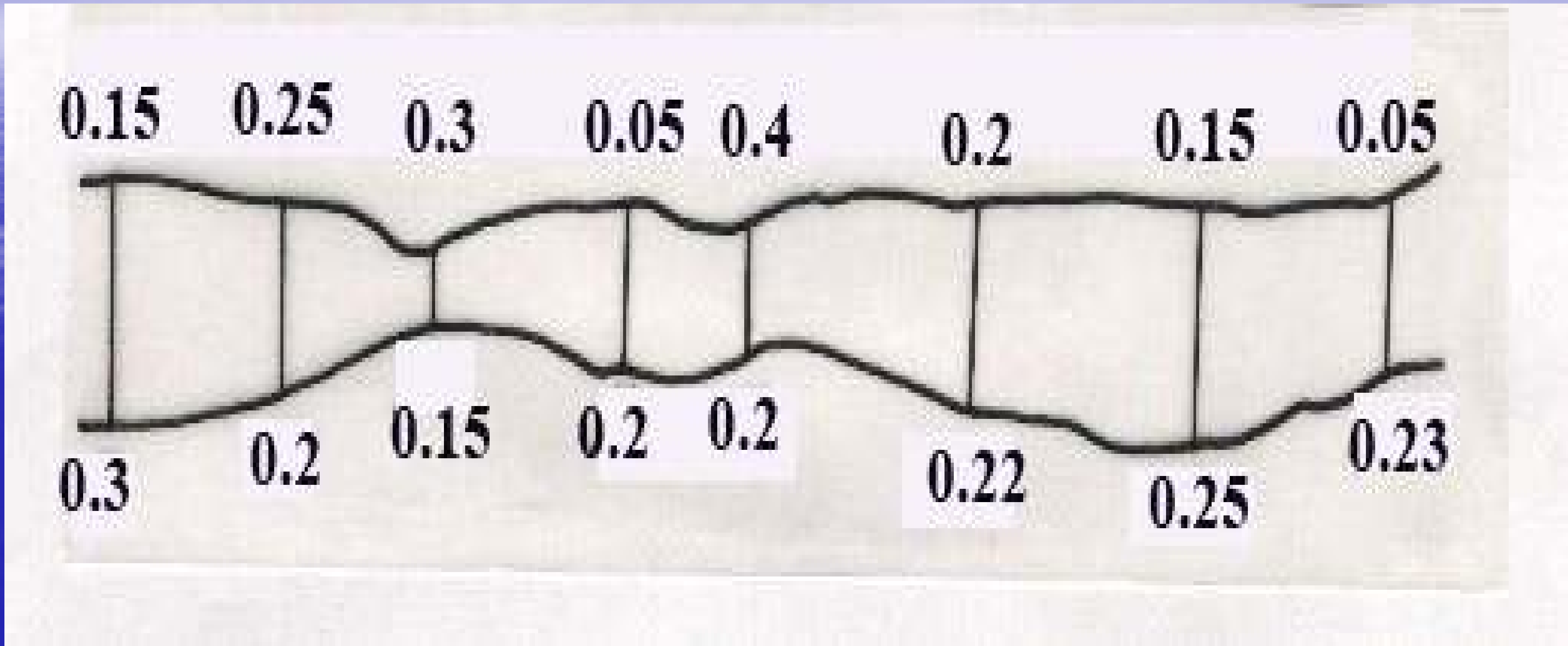


Fig. 4. Representation of sampling in a vein at two levels

Table 1: Mineralized zone in the bore holes and mine

Bore hole length		Mineralized zone (mine)	
m	%	m	%
0,50	0.20	0,50	0.20
0,50	0,50	0,50	0,50
0,50	0.20	0,50	0.20
Total:1,5	0.90	1.50	0.90
Average	0.30	-	0.30

Table 2:Unequal samples lengths

Bore holes		Mineralized zone (mine)	
m	%	M	%
0,20	0,20	0,20	0,20
0,80	0,50	0,80	0,50
0,50	0,20	0,50	0,20

Table 3: Determination of average concentration in uranium ore vein

Sample	U_3O_8 (C) %	Width (W)	C X W
A	0,20	0,20	0,040
B	0,50	0.80	0,400
D	0,20	0,50	0,100
Total	--	1,50	0,540

$$\text{Average concentration} = \frac{C \times W}{W} = \frac{0,540}{1,50} = 0,36\ \%\ U_3O_8$$

Table 4: Determination of average concentration and average width in uranium ore vein

Sample	U3O8 (C) %	Width (W) m	C X W
1	0.27	0.85	0.229
2	0.15	0.65	0.097
3	0.35	0.70	0.245
4	0.36	1.5	0.540
5	0.22	0.85	0.187
6	0,25	0.60	0.150
Total	--	5.15	1.448

$$\text{Average concentration} = \frac{\text{C X Total W}}{\text{Total W}} = \frac{1.448}{5.15} = 0,28\%\ U_3O_8$$

$$\text{Average Width} = \frac{\text{Total Width (5.15)}}{\text{Sample numbers (6)}} = 0.86\ \text{m}$$

In the case of variation in the distance between the channel samples there is another variable which is the length of the vein represented by each sample, which must be taken into consideration. On that, every sample must multiply with the height which represented by the sample. This is represented by a half of the distance that separates between the sample

and the previous sample and that followed one

$$\text{Average concentration} = \frac{\text{Width X Length X Concentration}}{\text{W X Length}}$$

$$\text{Average Width} = \frac{\text{Width X Length}}{\text{Length}}$$

If we considered that the six samples shown in the table 5 separated by different distances

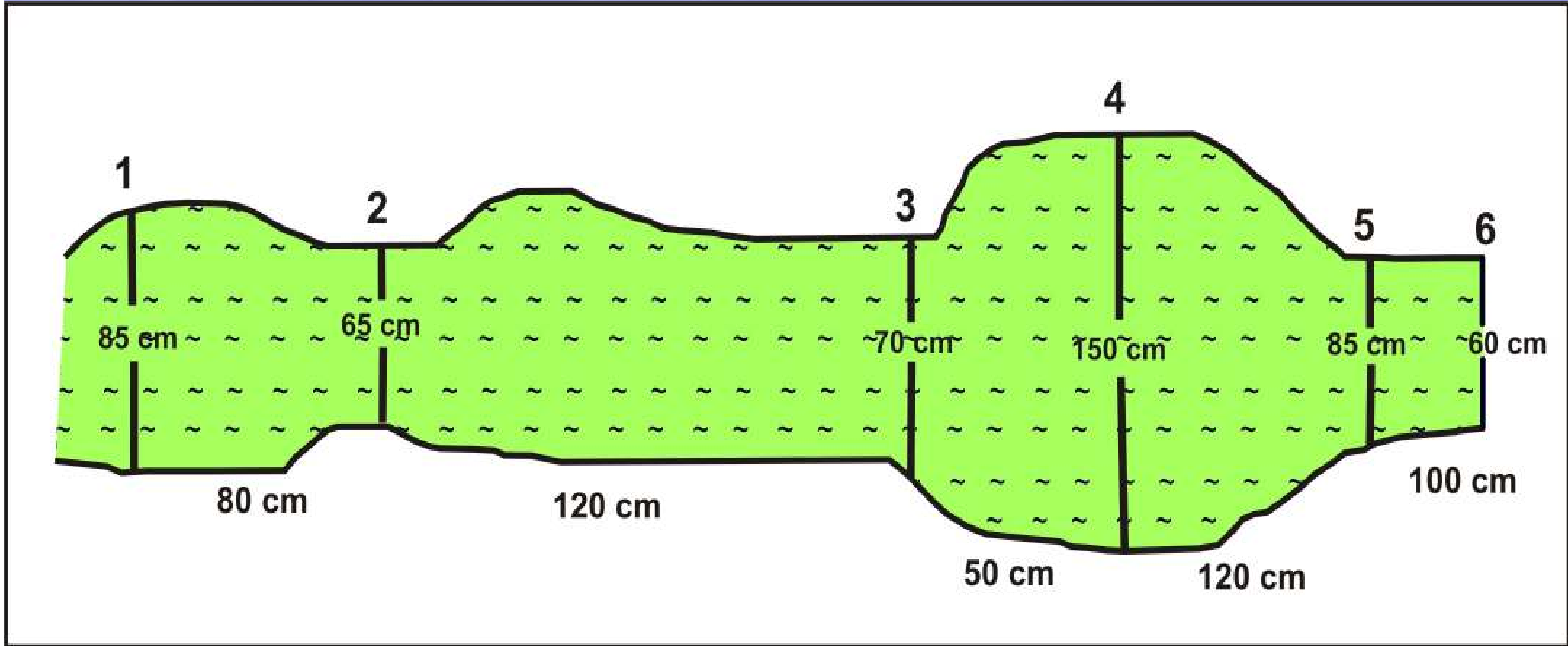


Fig.4: Section in a mineralized vein showing locations of uneven distances between samples

Table 5: Determination of average concentration in samples with different distances in between in uranium ore vein

Sample	U3O8 % (C)	Length (L) (m)	Width (W) m	L X W	L X WXC
1	0.27	0.85	0.85	0.680	0.183
2	0.15	1.20	0.65	0.780	0.117
3	0.35	1.05	0.70	0.735	0.257
4	0.36	0.85	1.5	1.275	0.459
5	0.22	1.10	0.85	0.935	0.206
6	0,25	1.00	0.60	0.600	0.150
Total	--	6.00	5.15	5.005	1.0372

$$\text{Average concentration} = \frac{L \times W \times C}{L \times W} = \frac{1.372}{5.005} = 0,247\%\ U_3O_8$$

$$\text{Average Width} = \frac{L \times W\ (5.005)}{L\ (6,00)} = 0.83\ m$$

The final result for this section of the samples of unequal distance between them for the average concentration is 0.27 % U3O8 and average width of the vein is 0.83 meters and 6 meters in length. It is clear that there is a slight difference in this result when compared to the previous one resulted from collected channels samples at equal distance of 1.0 meters.

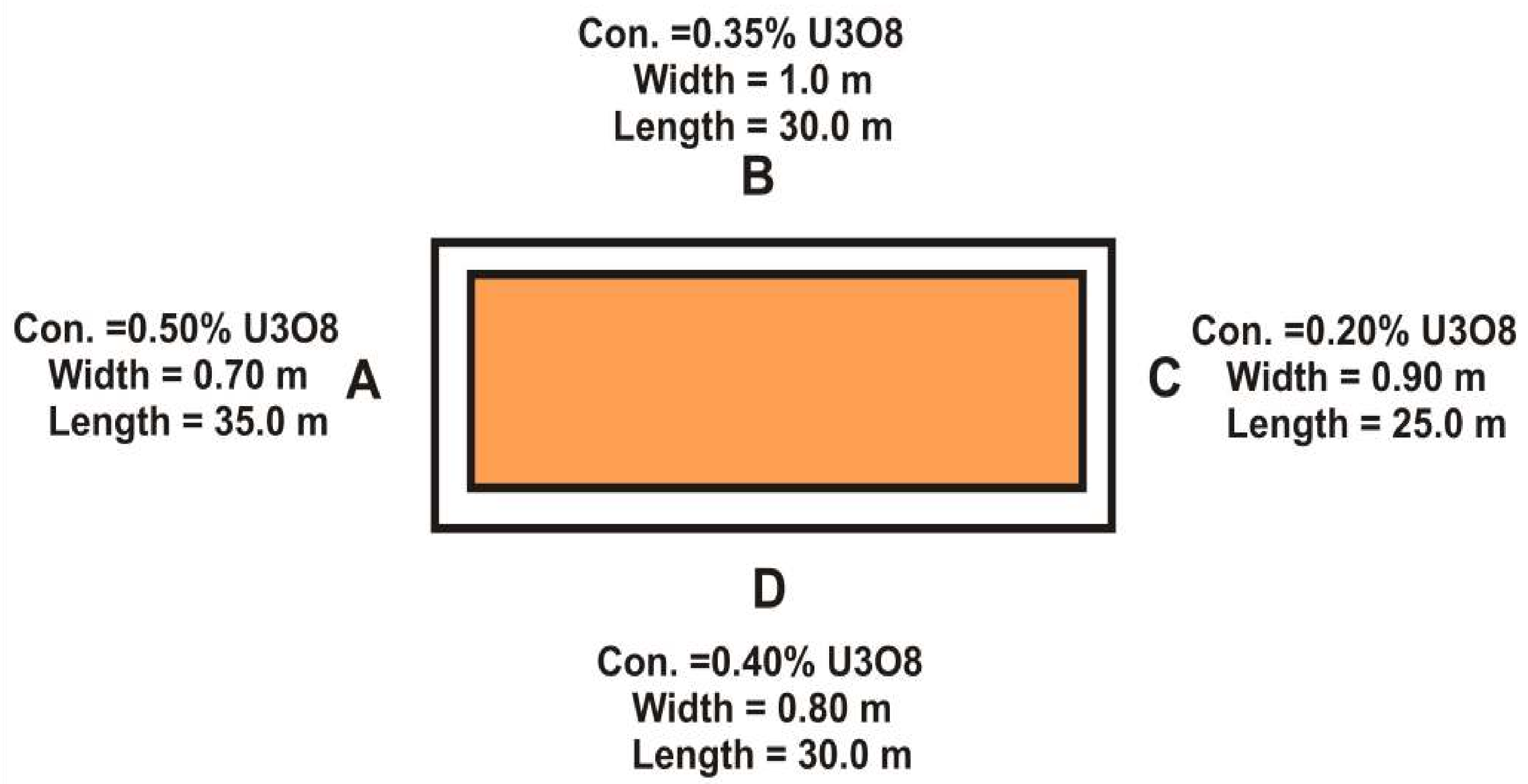


Fig.5: Vertical section in an ore block

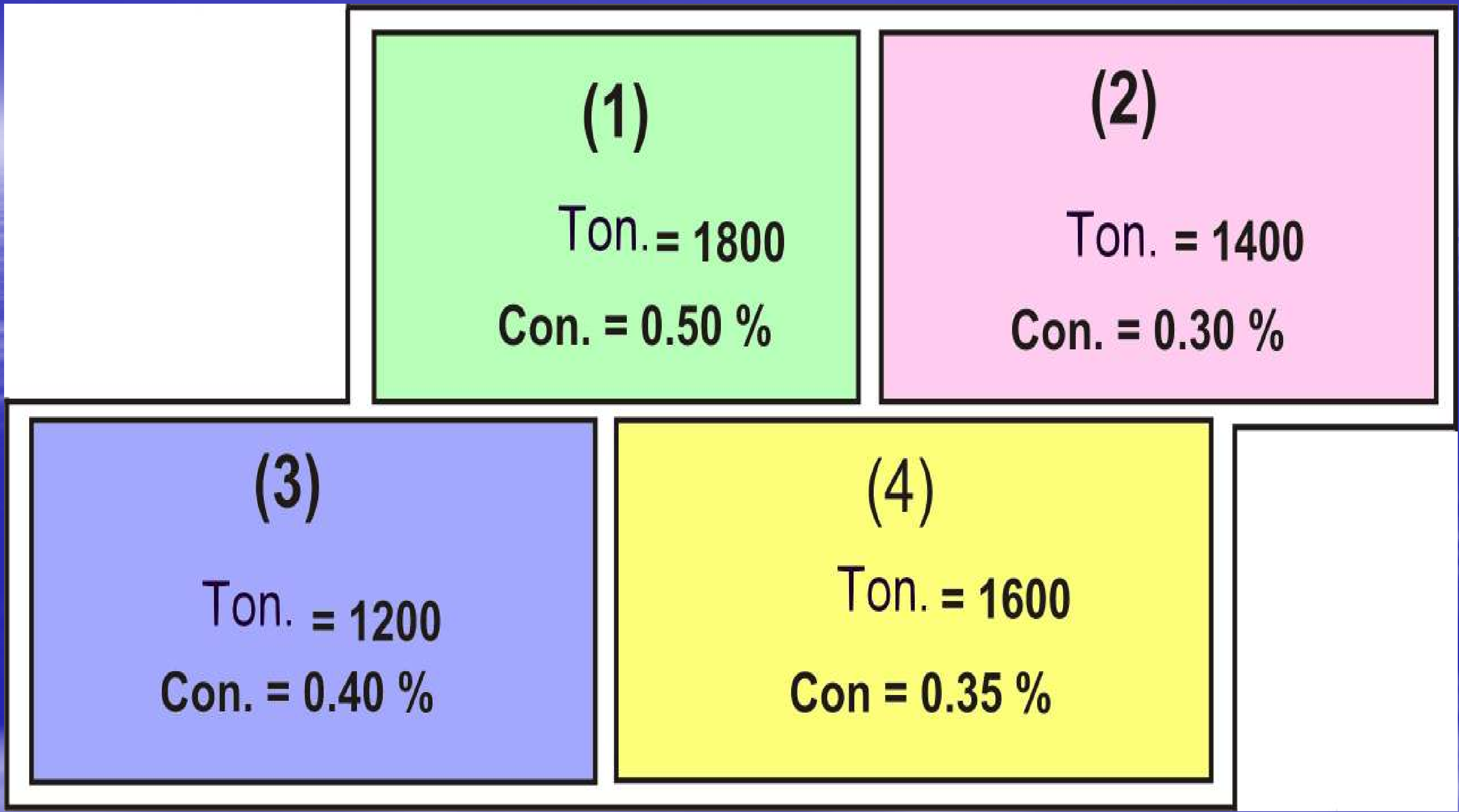
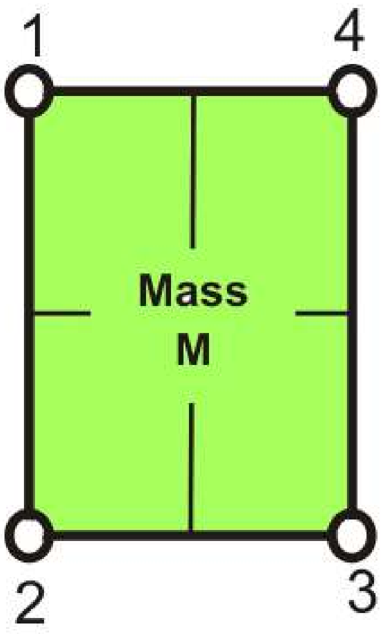


Fig.6: Distribution of ore blocks with tonnage and grade of each one



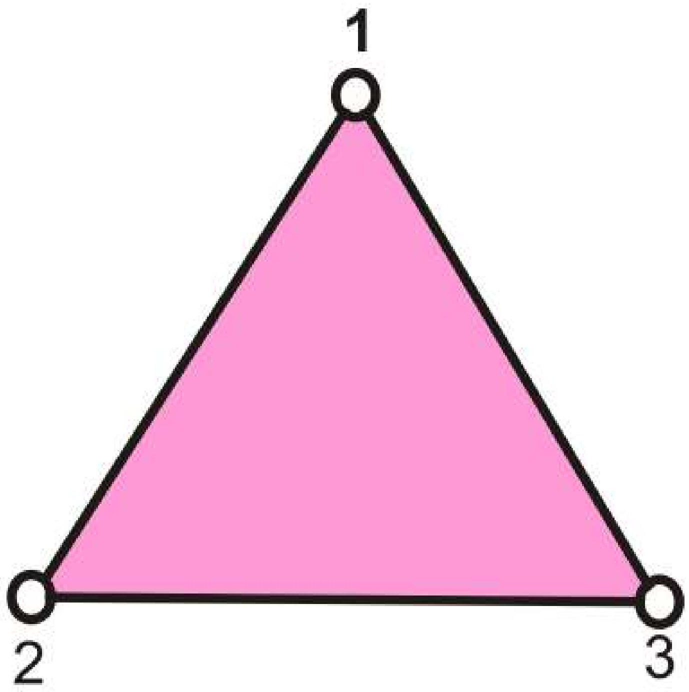


Fig.8: Quadrangle system

Fig. Triangle system

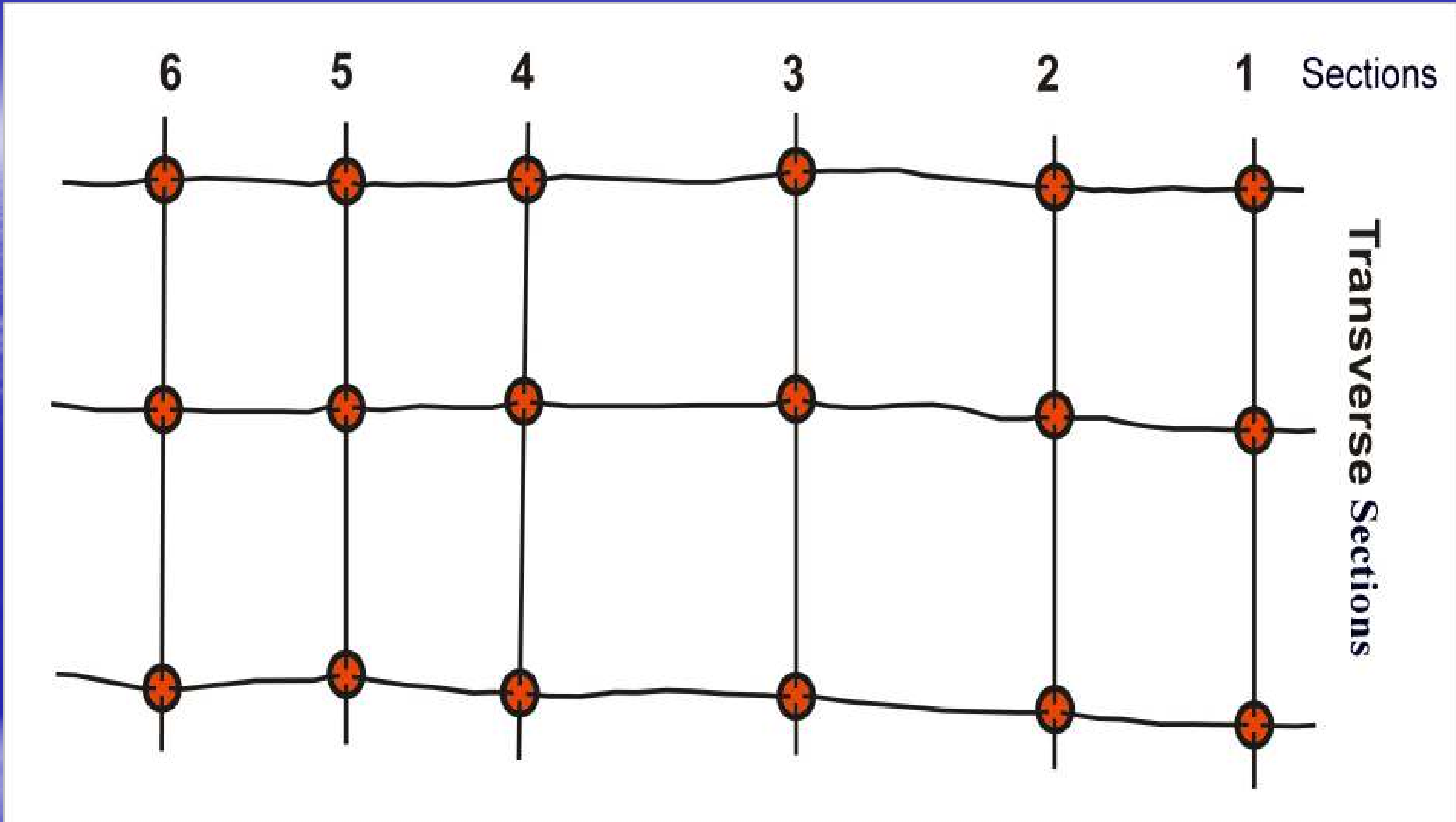
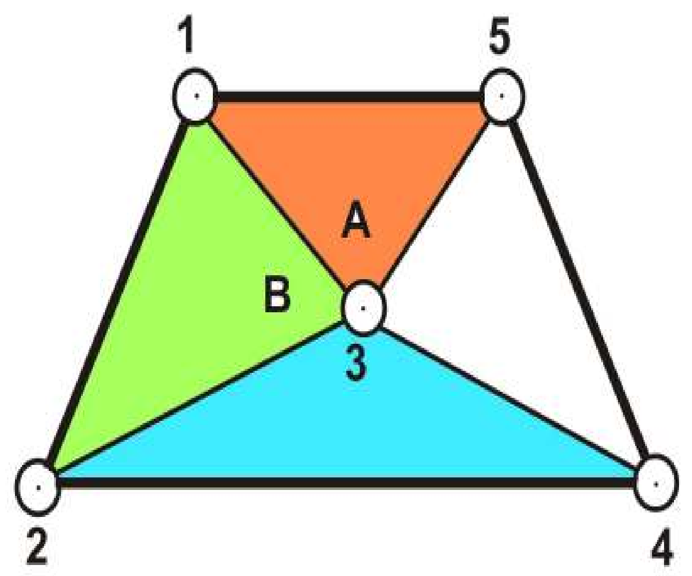


Fig.9: Drilling system on rectangle network



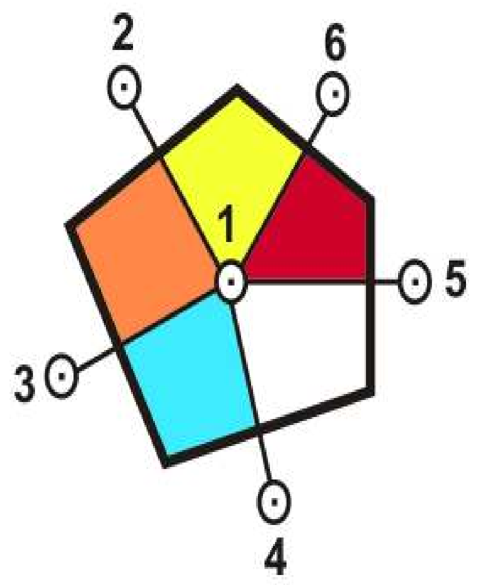


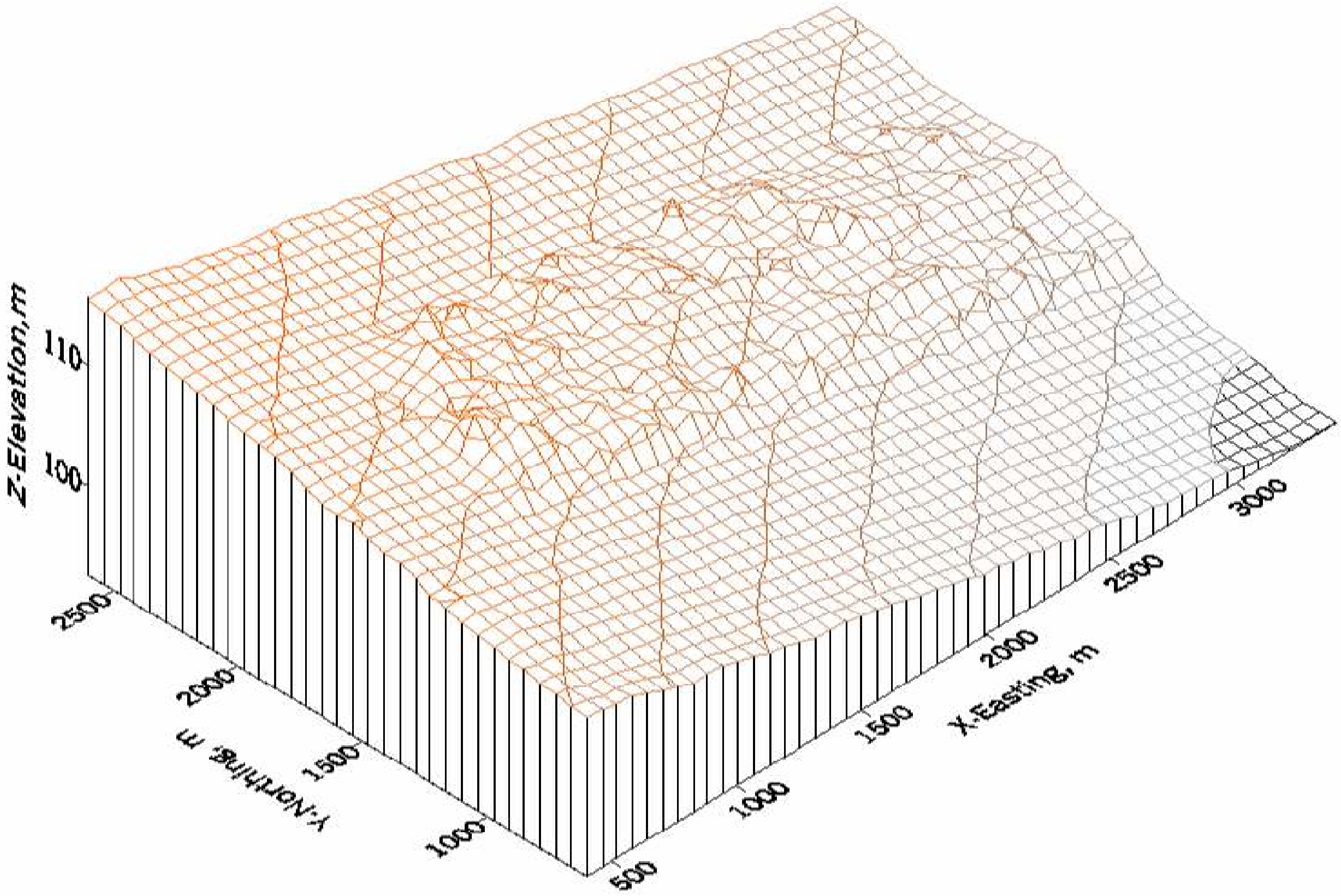
Fig. 10: Triangle system **Fig.11: Polygonal system**

Computer programs applications

There are several programs were developed for estimation of ore reserves, each firm often develop their own program which fit its ore characteristics.

A package is developed and applied by Mostafa, 2005, it is used only for the strata bound ore deposits. He applied it for reserve estimation of iron ore deposits in El Baharia iron ore deposits, Western Desert. However, it can be applied for any ore deposits including uranium ores.

It includes integrated modules for managing mine data :



Topographic mapping for mine area (Mostafa, 2005)

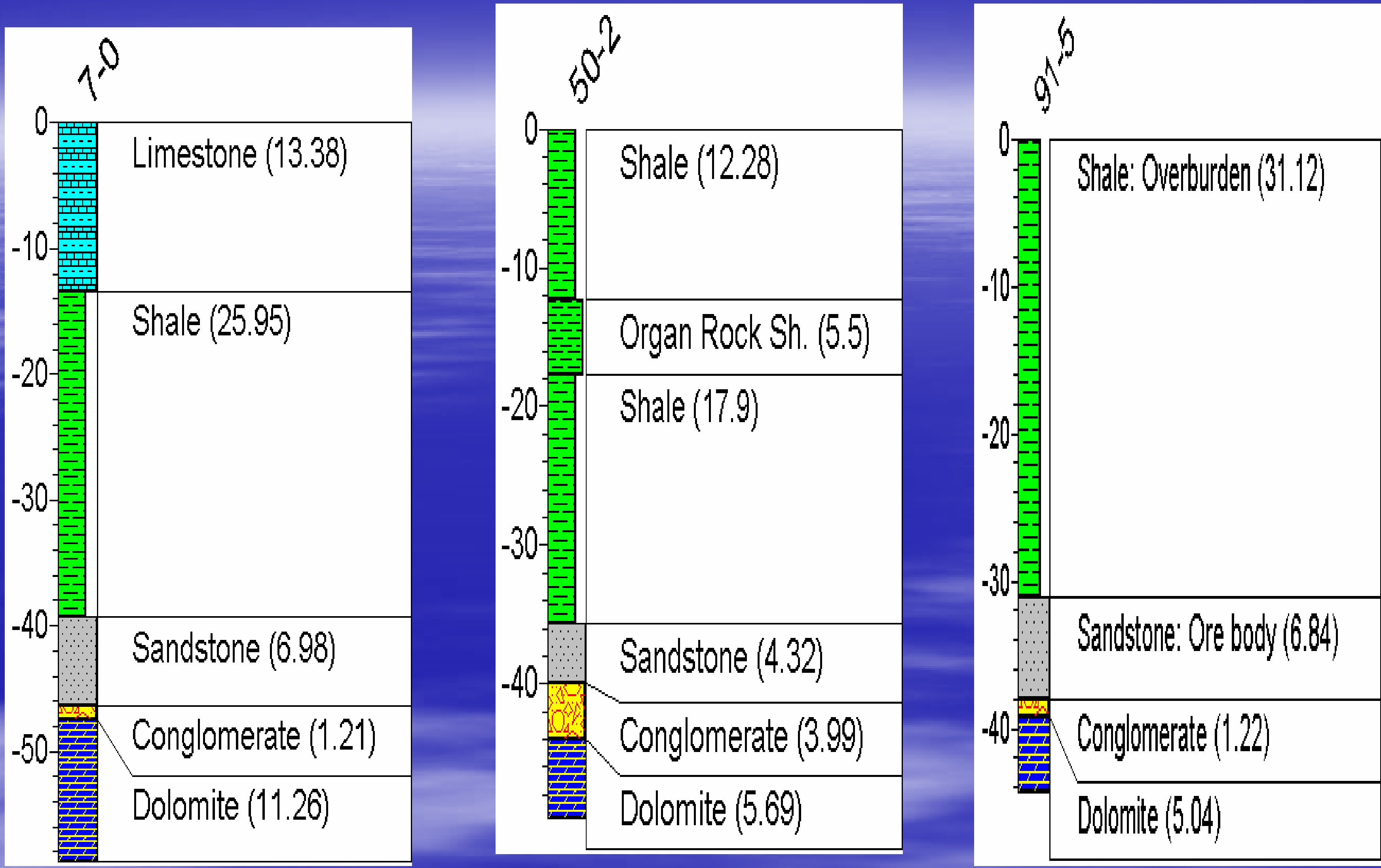


Fig. (4) Selected Borehole logs, the mining area. (BHN#7, Zone#0),(BHN#50, Zone#2), (BHN#91, Zone#5)

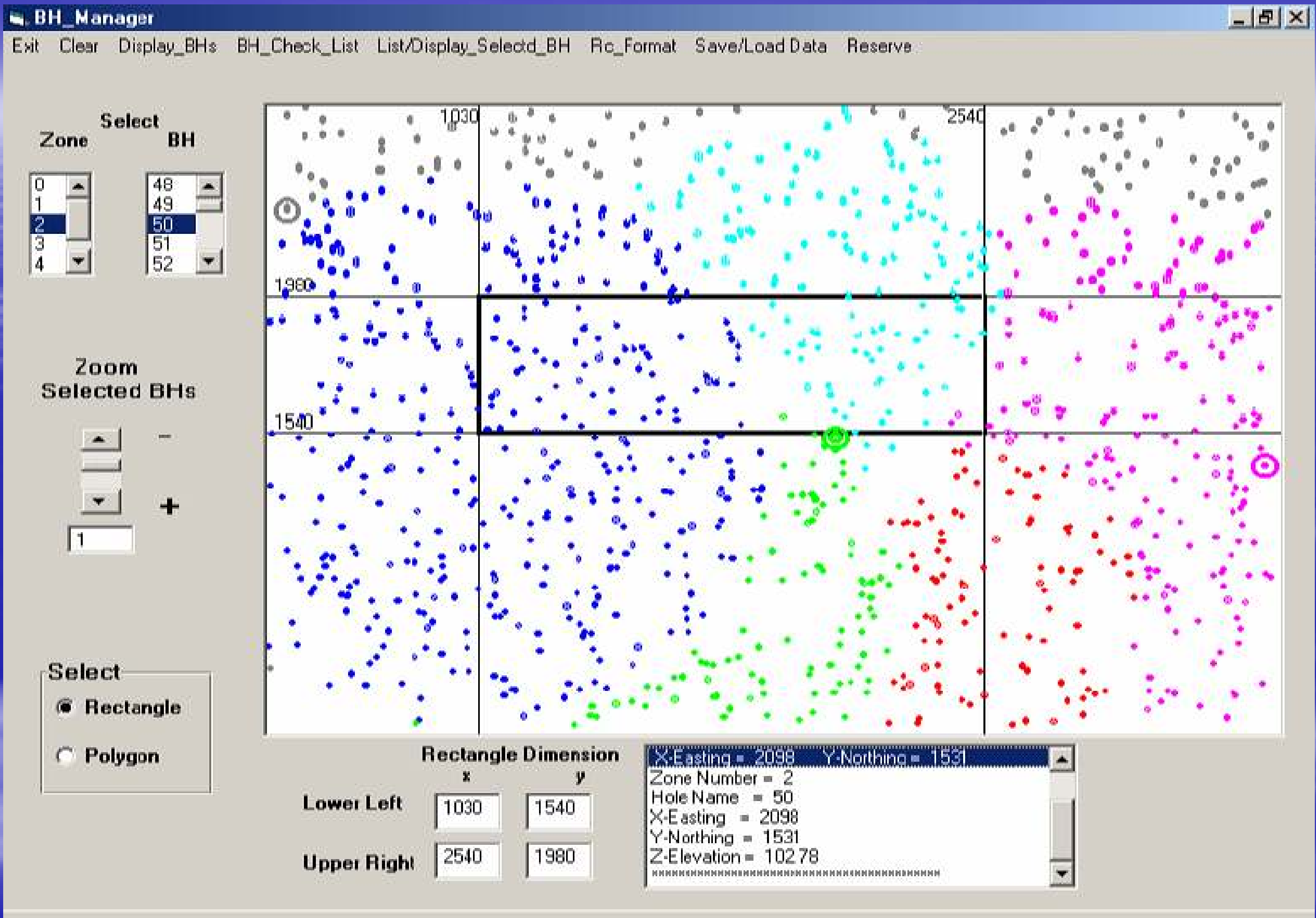


Fig. Interactive window for managing borehole data

Borehole check list (Feed in data)

- Zone Number = 0
- Bore Hole Name = 7
- X-Easting = 456
- Y-Northing = 2265
- Z-Elevation = 113.88
- Overburden = 39.33
- Bed-Thicknes = 6.98
- Bed Top Elevation = 74.55
- Bed-Base-Elevation = 67.57
- Total Number of Samples = 7
- Start Sample = 43
- End Sample = 49

Sample Assays

Fr	To	C1	C2	C3	C4	C5	Length
074.55	073.55	015.24	007.82	011.05	014.57	009.15	01.00
073.55	072.55	017.17	011.69	009.66	009.26	013.02	01.00
072.55	071.55	019.67	016.69	006.47	018.01	015.63	01.00
071.55	070.55	017.23	011.81	011.39	015.26	013.52	01.00
070.55	069.55	020.20	017.74	008.02	025.57	004.81	01.00
069.55	068.55	020.40	018.15	006.34	015.75	001.20	01.00
068.55	067.57	015.92	009.19	003.21	021.60	005.64	00.98

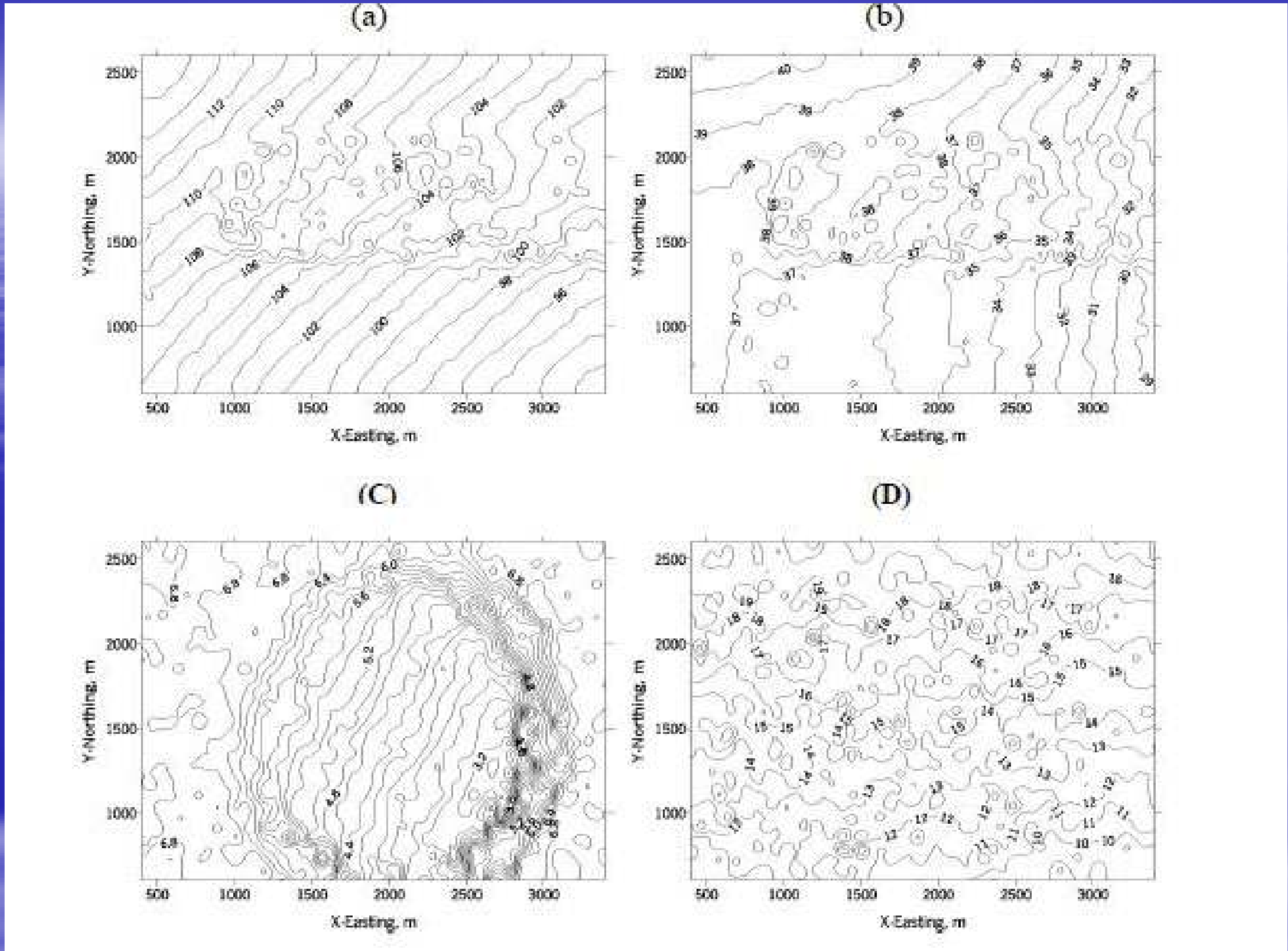


Fig. Contour maps:

a- Topography b- Overburden

c- Ore bed thickness d- C1-Component assay

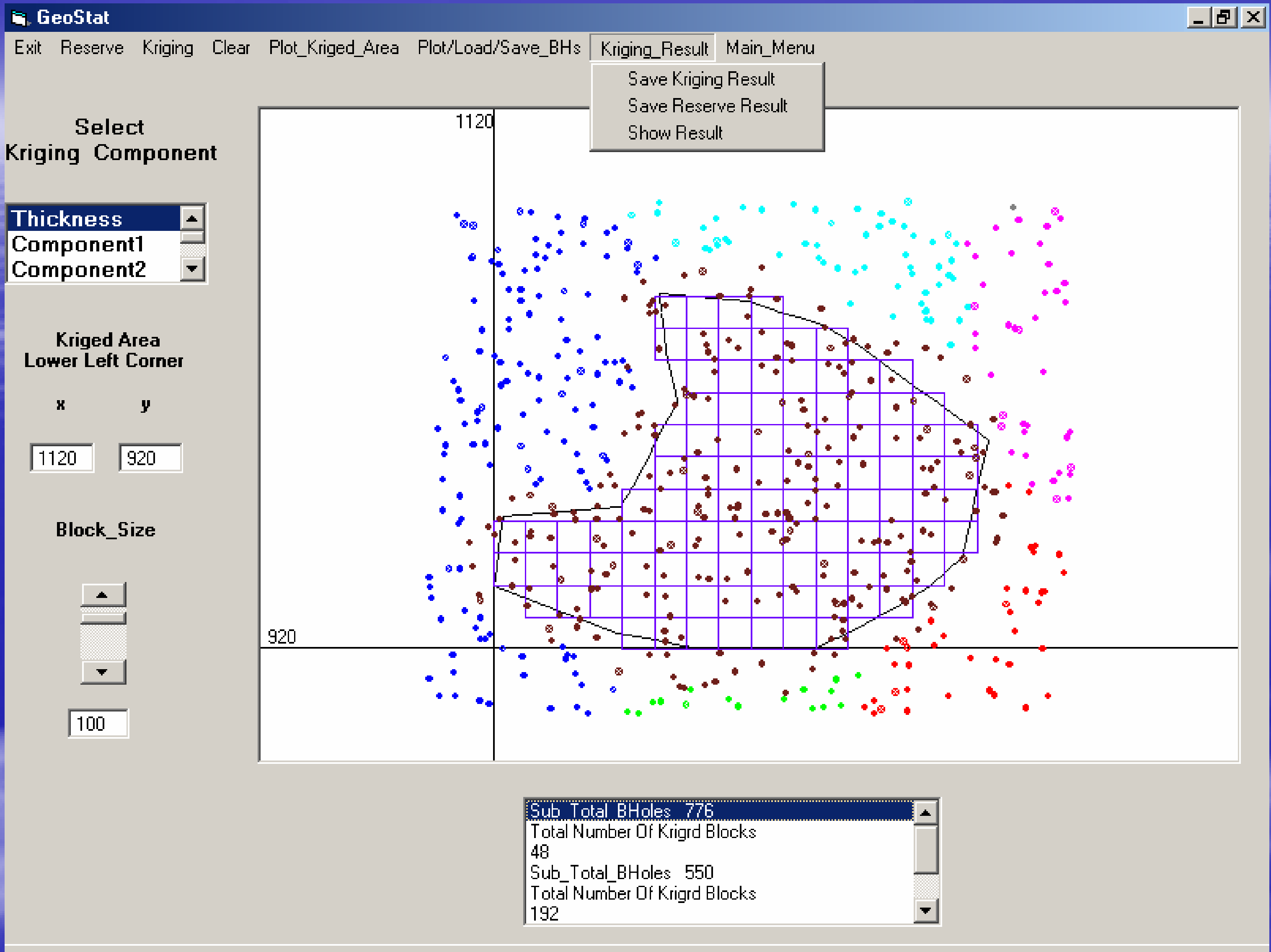


Fig. Interactive window for geostatistical analysis

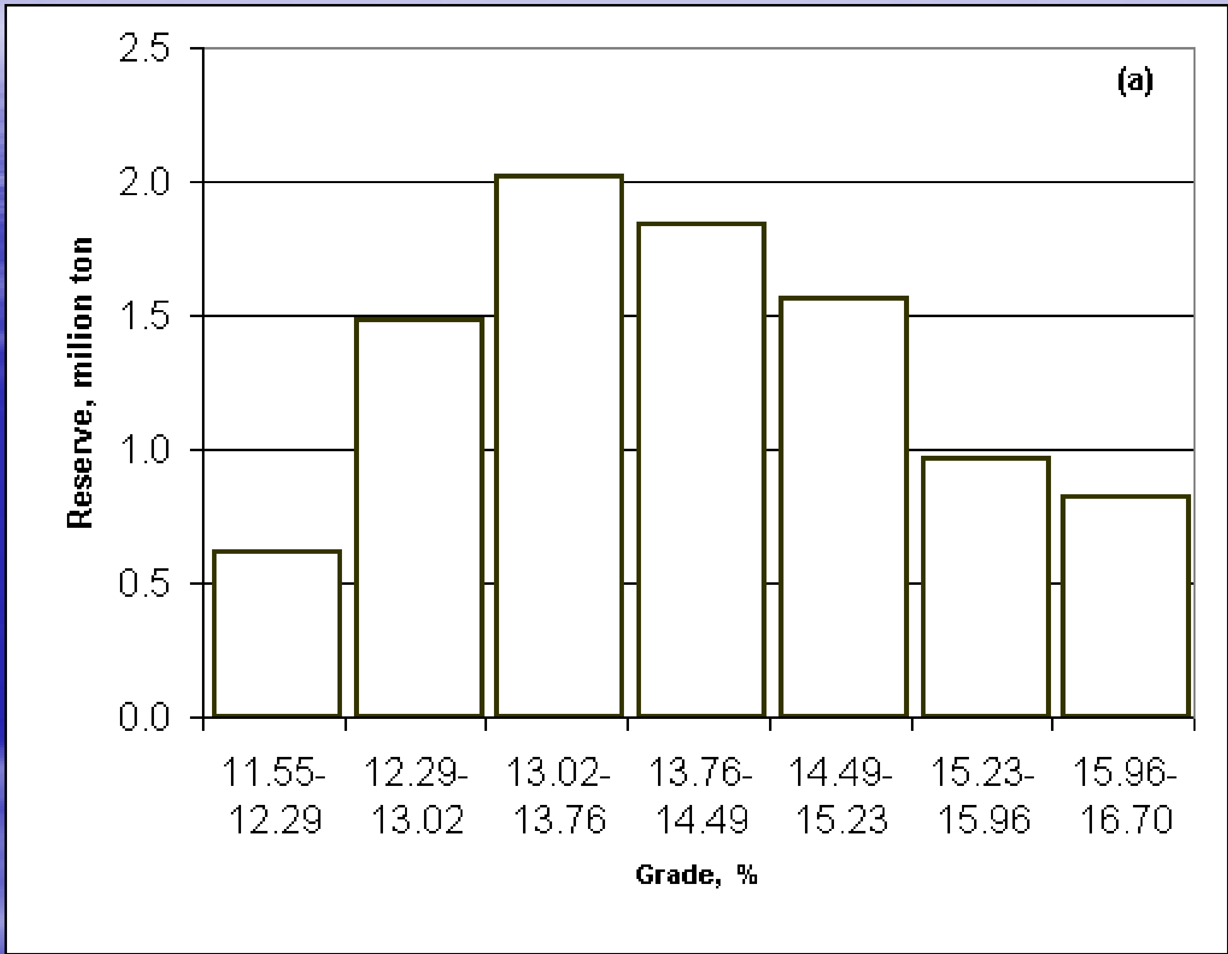
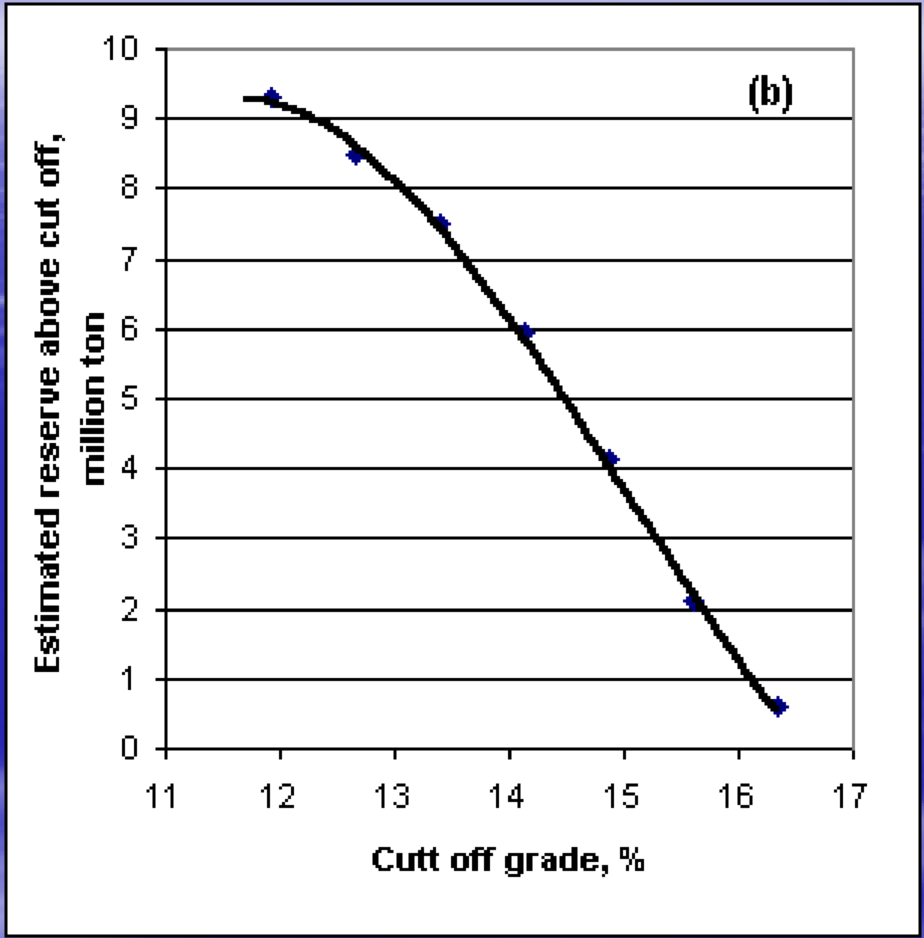
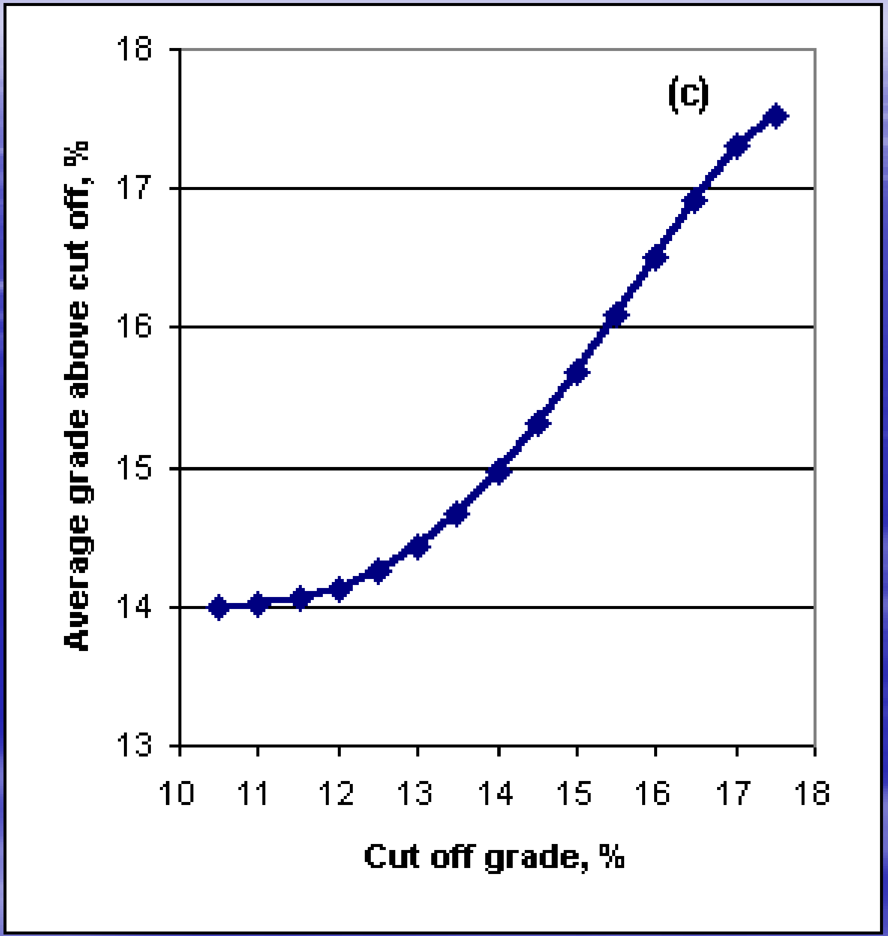


Fig. Grade/tonnage/cut off distribution of C1 component (estimated blocks = 100x100m)

a- Histogram



b- Cumulative curve



c- Cut off/average grade curve

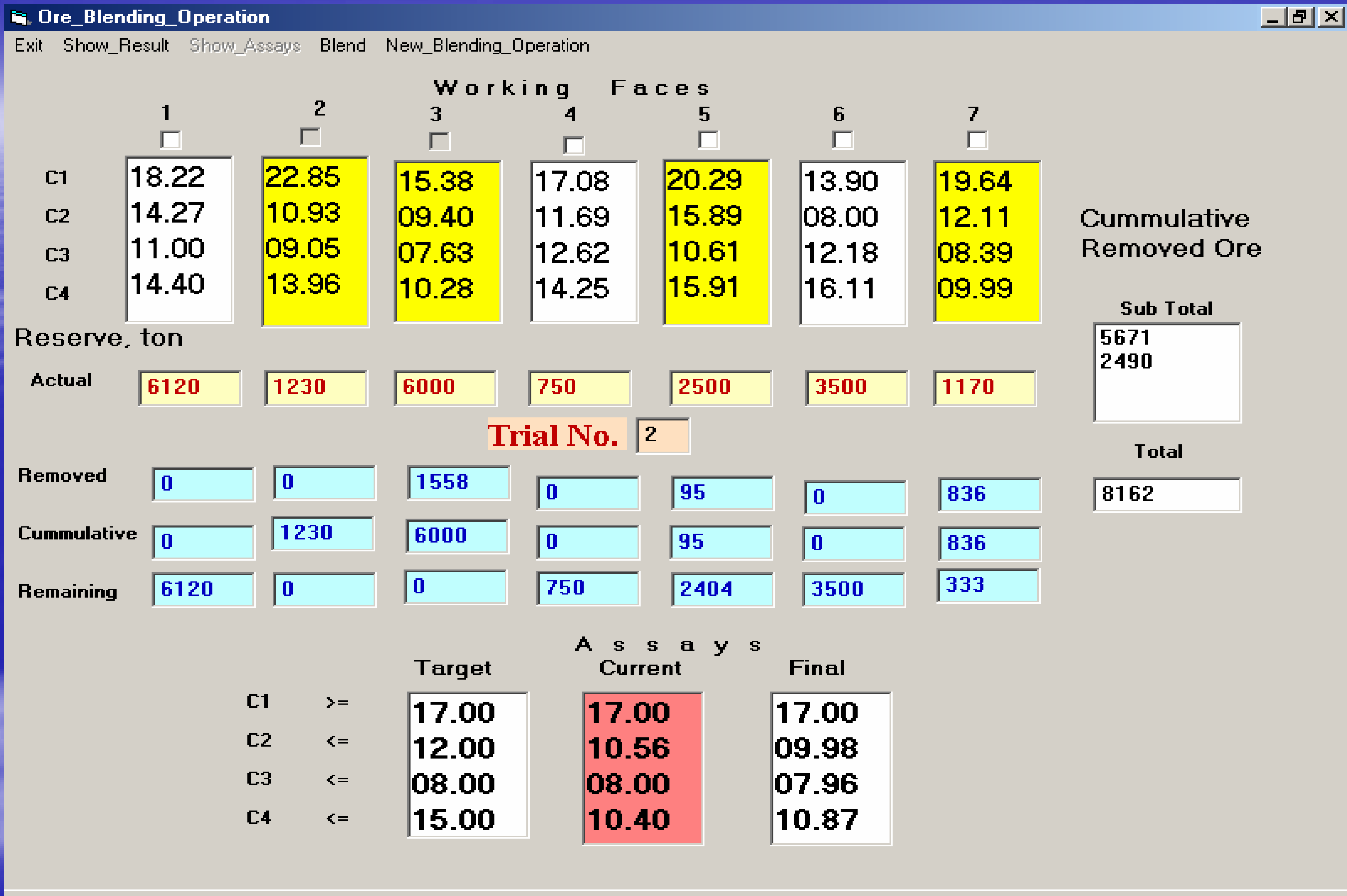


Fig. Blending operation from seven mine working faces **(Mostafa, 2005)**

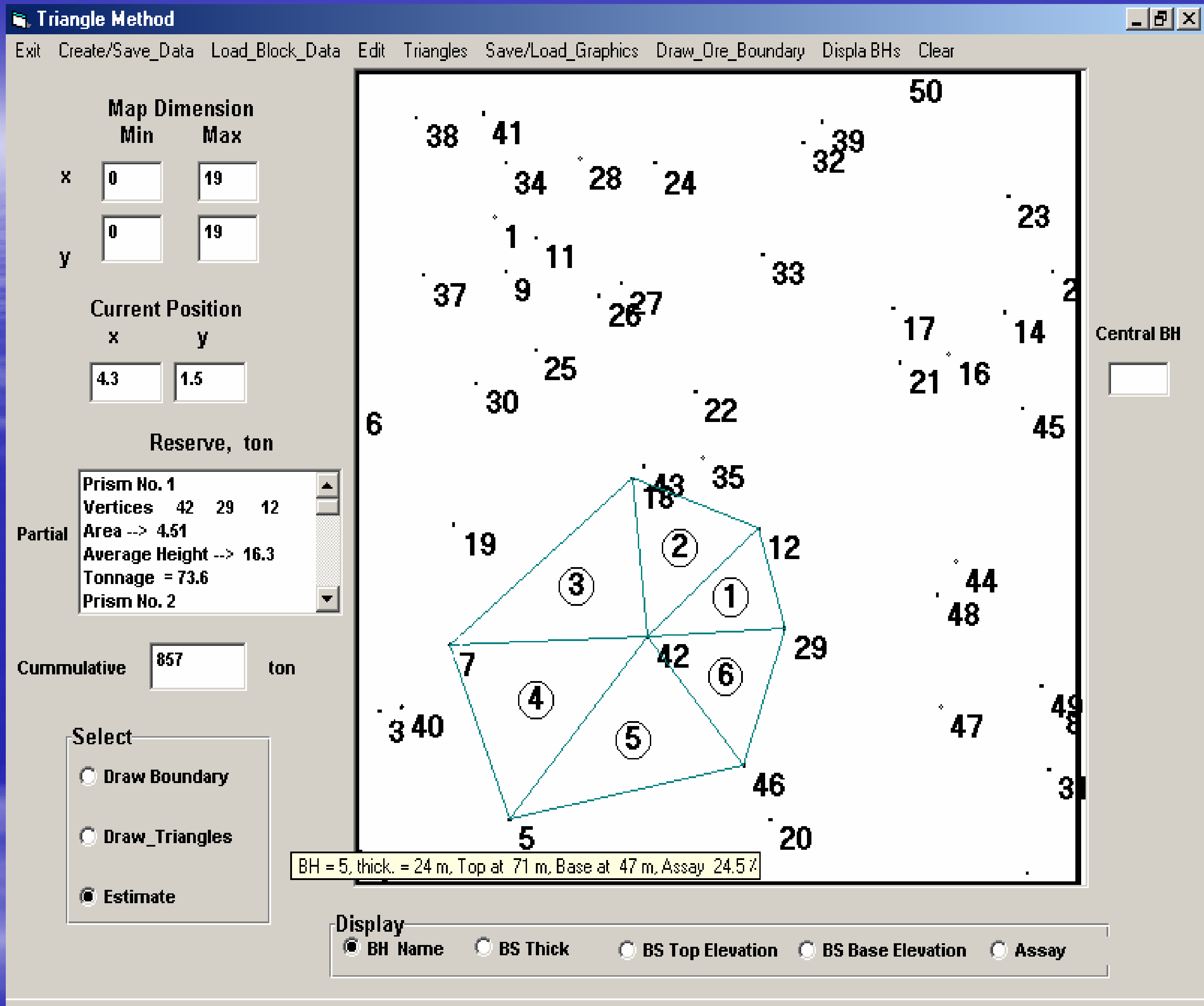


Fig. An interactive window for reserve estimation by the triangle method

Table : Summary of reserve estimation using the triangle method

Triangle number	Vertex number			Ton, million	Weighted average%
	V1	V2	V3		
1	42	29	12	73.6	29.24
2	42	12	18	98.4	26.50
3	42	18	7	166.8	27.80
4	42	7	5	223.9	26.95
5	42	5	46	204.2	30.69
6		46	29	89.9	32.55
	Overall tons			856.8	
	Average Grand %				28.96


THANK YOU