Mine Planning and Equipment Selection 1998, Singhal (ed.) © 1998 Balkema, Rotterdam, ISBN 90 5809 011 6

Computer regulation of the condition reserves contours

B. Rakishev, J. Ashaev & Zh. Imashev
Kazak National Technical University, Almaty, Kazakstan

ABSTRACT: For the compound-structural multi-component deposits one of the most laborious problems at the stage of initial treatment of geological information is the picking of the conditional intersections - the aggregate of deposed consecutively samples. The last ones must answer the demanded conditional limitations at mineral raw material and be a some row of the appointed typosort of ore or rock at the deposit considering part. The work effectiveness and reliability by this depends vastly on the executor's experience and intuition. The large volume of initial information, a lot of variants of its interpretation and problem decision's multicipherness demand scientifically grounded approach to determination of the conditional intersections with the computers use. At the base of the elaborated algorithm the automated picking of the conditional intersections is proposed.

DISCUSSION AND NEW OBSERVATIONS.

The determined conditions serve a base for geometrization of the ore bodies. They allow to define the elements of the stratum bedding (thickness of a seam, the intersection point of the geological-prospecting excavation with the bed and so on), provide the subsequent contouring of the ore bed and the reserves calculation.

The problem's specificity lies in the fact that for the compound-structural multi-component deposits a lot of variants of the conditional intersection picking can be received, which satisfy in whole the general demands of the conditions, but not provide the choice of the optimal decision. Besides that, owing to the force of the subjective factors, even the experienced specialist can't avoid the inexactitudes. The last ones can lead to distortion of the approving reserves of the deposit, and by the calendar planning of mining works - to the unwarranted losses of ores due to the setting of the uncorrected contours of the working - out. Thus, the computer use by solving of this problem will allow to raise the completeness of the reserves extraction even within the limits of the approved earlier conditions without their additional revision. The more so, as the practice shows, the conditions re-approval is laborious enough and long process, requiring the certain capital investments.

Some results, received as a result of formalisation of the problem and its automated solution with the computer use, are adduced below. The data of the exploitation prospecting for the compound-structural multi-component deposit of phosphoric ores by planning of their extraction under the conditions of the working quarry have been used in the calculations. In all the 160 geological-prospecting excavations have been reated at the computer. The data of sampling for the several sections at the different horizons of working have been used. That is why we can consider with some assumption that the received dependencies are typical for all the deposit in whole. As the standard information for analysis of the results of the automated computations the data of calculations, made by the high-qualified specialists of the geological department of the mining enterprise ore-administration, have been used.

The automated picking of the conditional intersections has been carried out at the base of the elaborated algorithm, the essence of which is the following. According to the given conditional limitations the relative meaning of the typosort is conferred upon the every sample, in result of which the supporting distribution of samples is formed. The adjacent samples of the same sortness are jointed in the conditional intersections, after which the addition of the boarding samples to the intersection is fulfilled. By this the sample, adjacent with the intersection of the more high in quality typosort, is analysed on conformity to the conditional limitations to the boarding content for this typosort. If the sample satisfies the condition requirements and the higher typosort is remained by jointing, the sample and intersection are united into the new intersection of the greater thickness. The rest samples are included in the conditional intersections with due regard for providing of the picking of balance ores with the maximum thickness. The results of traditional "manual" and automated picking of the conditional intersections in one cut for the considering deposit have been adduced at the Figure 1.

The labour expenses for the conditional intersections picking with the calculation of reserves and giving out of all the necessary forms in evaluation at the one geological-prospecting excavation by the traditional manual technology is estimated in 11-13 hours for the one variant of the conditions. By the automated system use these

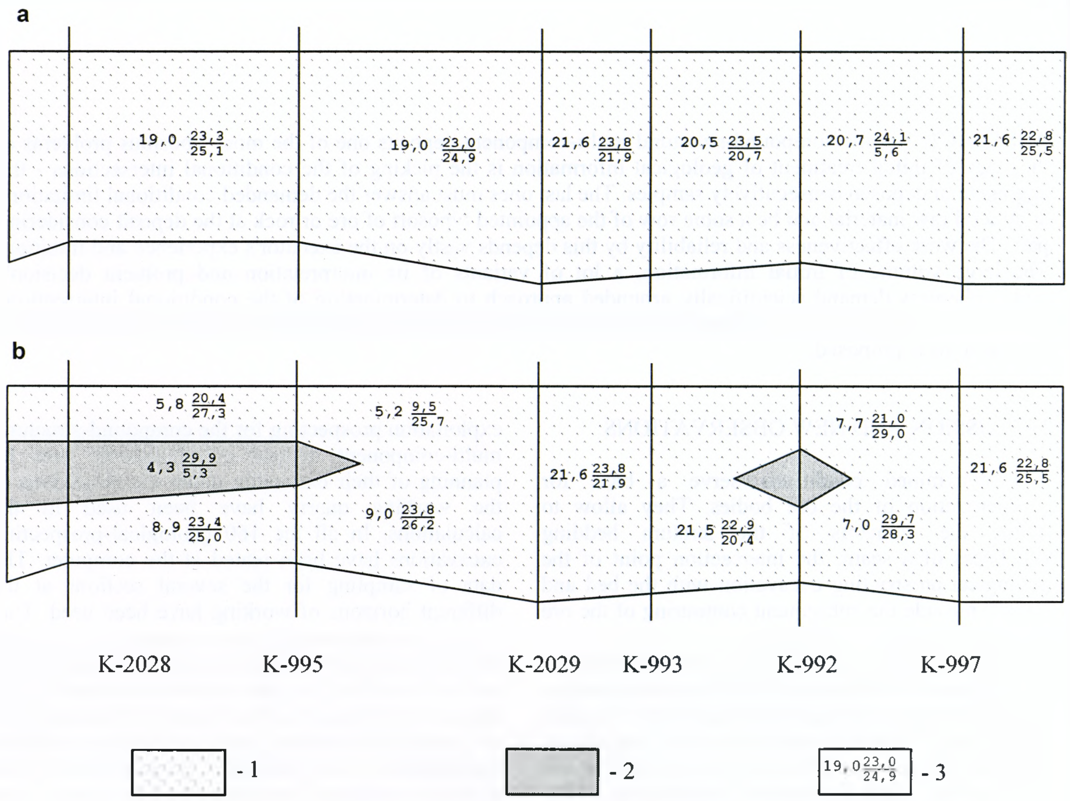

Figure 1. The variants of the manual (a) and automated (b) picking of the conditional intersections:
1 - ordinary ores; 2 - ores of high quality; 3 - the intersection thickness (m) and content.

expenses present 15-30 minutes with taking into account the preparation, input, control and correction of the initial data. If the calculation were carried out for the several variants of the conditions, the ratio of the labour expenses by the traditional and automated computations will be even more essential.

The many variants of solving the problem of the conditional intersections picking predetermine the getting of the certain regime of calculations, providing the optimal meaning of the chosen criterion. The one of the following conditions may be chosen as such criterion:

- ensuring of the maximum thickness of balanced ores;
- priority picking of ores of high quality;
- ensuring of the homogeneity of ores of the different typosorts.

The data fragments of the reserves calculation by the traditional manual and automated methods of the conditional intersections picking are adduced at the Table 1.

Table 1. The results of the ores reserves calculations by the conditional intersections picking by the traditional method and with the computer use.

Section	The traditional method				With the computer use			
	V_q, ths.t	V_o, ths.t	V_b, ths.t	V_q/V_o	V_q, ths.t	V_o, ths.t	V_b, ths.t	V_q/V_o
I-G10-S	0	444.90	444.90	0	0	457.90	457.90	0
I-G9-S	0	700.50	700.50	0	0	705.56	705.56	0
II-G10-S	48.23	534.51	582.72	0.09	89.851	501.92	591.77	0.17
II-G9-S	38.47	547.60	586.07	0.07	116.72	470.25	586.97	0.24
II-G8-S	30.30	555.33	585.63	0.05	121.36	472.02	593.38	0.25
II-G10-V	0	435.38	435.38	0	32.16	408.00	440.16	0.07
II-G10-N	48.23	99.13	147.36	0.48	57.69	93.92	151.61	0.61
III-G10-N	23.14	61.75	84.89	0,37	28.23	81.26	109.49	0.34

The table data show that by the automated computations one can avoid entirely the mistakes, which are typical for the traditional manual calculations. They allow to exclude the situation, when the part of balanced ores is lost because of the specialist-geologist can't secure the optimal result for every excavation by the manual calculations.

The new approach is especially important for the multi-component compound-structural deposits, for which the conditional limitations are given by the several components (Rakishev, 1993). Besides that, by the automated computations at expense of the more deep analysis of the quality indices of the geological-prospecting excavations samples with in the balanced ores limits the ores of high quality are picked out, i.e. the re-distribution of balanced ores in direct of increase of ores of high quality are carried out. This circumstance is illustrated clearly at the graphs, adduced at the Figure 2, 3. The comparison of the results of the automated and manual calculations is presented schematically at them.

The curves at the graphs are situated above the bisector, characterising the equality of the results of the manual and automated calculations, which is

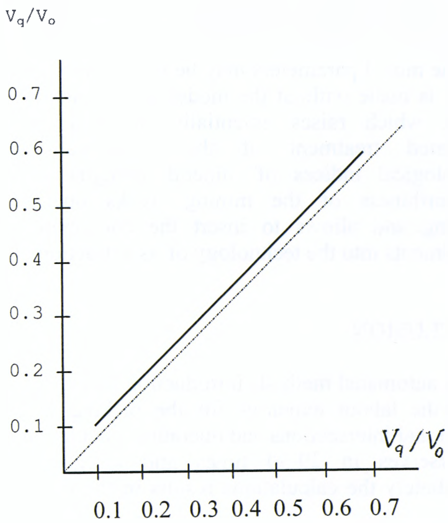

Figure 2. Correlation dependence of reserves of high quality ores and ordinary ones by the manual (the abscissa axis) and automated (the ordinate axis) picking of the conditional intersections

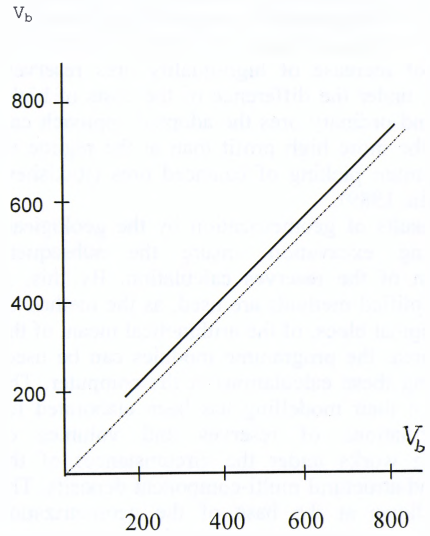

Figure 3. Correlation dependence of balanced ores reserves by manual (the abscissa axis) and automated (the ordinate axis) picking of the conditional intersections.

evidence of preference of the computer use.

Besides the stated the opportunity of priority picking of high quality ores offers. Such necessity appears at the mining-extracting enterprises periodically by raising of the requirements to the form of the volume lattice. The data by the geological-prospecting excavation are noted down at the nearest junction of the space lattice. Owing to irregularity and rarefaction of the sampling net only the part of the lattice junctions is filled up by the real

Table 2. The comparative results of the reserves calculations by the priority picking of high quality ores in the automated regime.

Section	The traditional method			With the computer use			V_q increase dol.unit	V_b decrease dol.un
	V_q, ths.t	V_o, ths.t	V_b, ths.t	V_q, ths.t	V_o, ths.t	V_b, ths.t		
III-G9-N	14.87	75.73	90.60	21.79	60.21	82.00	0.46	-0.09
II-G9-N	38.47	114.95	153.42	77.59	68.16	145.75	1.01	-0.05
II-G8-N	30.30	112.40	152.70	51.42	99.64	151.06	0.69	-0.01
III-G8-N	3.13	95.65	98.78	25.46	65.79	91.25	7.13	-0.07

quality of extracting mineral raw material. At this case the increase of reserves of ordinary and high quality ores by the geological-prospecting excavation is realised at expense of transfer of their some part to the beyond-balanced ones, i.e. to the detriment of the general reserves of balanced ores.

As an example at the Table 2. the data of calculation of the balanced reserves by the several typical sections are adduced. As is obvious from the Table 2., the balanced ores reserves by every of the considered sections descrease to some extent. However, if somebody compares the rates of accretion of high-quality ores with the rates of decrease of balanced ores, he will see clearly the priority of increase of high-quality ores reserves. Actually, under the difference of the costs of high-quality and ordinary ores the adopted approach can provide the more high profit than at the regime of the maximum picking of balanced ores (Rakishev, Esenberlin, 1989).

The results of geometrization by the geological-prospecting excavation ensure the subsequent perfection of the reserves calculation. By this, if such simplified methods are used, as the method of the geological blocs, of the arithmetical mean, of the nearest area, the programme modules can be used, automating these calculations at the computer. The method of their modelling has been elaborated for the calculations of reserves and volumes of extracting works under the circumstances of the compound-structural multi-component deposits. The model allows at the base of the geometrization results by the geological-prospecting excavation to fulfil the contouring of the ore bodies and the reserves calculation by the different variants of the conditions.

The method of the mathematical modelling is based at the geological space representation at the

geological data, and the rest are supplemented with the results of interpolation. By interpolation the Laplas equation is used, providing the minimum of variations of the geological parameters meanings between the points with the known data. By interpolation process of the useful component contents the gradual content lowering takes place from the section with the high concentration to the sections with the more low content. And the area of the method application is conditioned by this. By modelling data at the base of conditions the picking of the industrial sorts and types of ores is fulfilled, after this the reserves calculation is carried out. In the process of receiving of the exploiting prospect data the model parameters may be made more exact. And it is made without the model reconstruction in whole, which raises essentially its value. The automated treatment of the geological and technological indices of mineral strengthens the trustworthiness of the mining works operating planning and allows to insert the corresponding amendments into the technology of its extraction.

CONCLUSION

1. The automated methods introduction allows to cut down the labour expenses for the picking of the conditional intersections and operating calculation of the reserves in 20-30 times and to give out immediately the calculations results in the required form.

2. The proposed method use provides the possibility to re-calculate the reserves in the shortest time with account of the new conditional limitations.

3. The, automated methods introduction allows to avoid the mistakes, peculiar to the traditional manual calculations and to raise the accuracy and

trustworthiness of the results.

4. By making more exact the contours of the ore beds the opportunity offers to decrease of the mineral losses. For the conditions of phosphorite ores of the compound-structural multi-component beds the completeness of the reserves extraction from entrails can be increased to 2,5%.

5. The automated calculation of reserves provides the possibility of the detailed account of balanced (high-quality and ordinary), beyond-balanced ores and passing non-ore-building materials.

6. By the operating planning of mining works at the quarry the elaborated method allows to regulate the volumes of the ore blocs accordingly to the requirements for the quality of raw material and to control the technology of their extraction.

REFERENCES

Rakishev, B.R. 1993. The strategic problems of complex use of mineral raw materials. Complex use of mineral raw materials, No 6, Almaty.

Rakishev, B.R., Esenberlin K.I., 1989. The determination of productivity of the quarries group when many criterions. Mining magazine, No 8 , Moscow.