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ETHICAL PROBLEMS IN REPORTING GEOLOGICAL EXPLORATION DATA AND ITS USE IN PLANNING OF MINING ACTIVITY

Abstract: *Geological report is the basic tool of presentation of results of geological field work. It is used in various practical applications. The ethical problems of their presentation and geologist responsibility of it are seldom discussed. The possibility of immediate verification of geological data and interpretation is limited and utilization of geological reports is based on confidence as to its correctness. Geologist should be always aware of professional responsibility. All doubts on data and interpretations should be presented to the customer of report, to avoid erroneous or harmful its understanding and utilization. Because the possibility of not correct interpretations of geological data exist, due to the imperfectness of geological knowledge, the opinion of independent person is always indispensable.*

Key words: *geoethics, geological reports, mineral deposits*

Responsibility in reporting geological results of exploration is the important ethical issue. Ethics – is the system of rules and appraisals of human behavior and attitudes, admitted as proper in relation to actions recognized as good or wrong. Professional ethics is the system of rules of behaviors which warrants correct and proper performance of professional duties considering further utilization of their results [1]. Such system of rules should be applied in geological exploration and presentation of gained results.

Geological reporting of exploration results is the basic mode of presentation of geological information on studied mineral deposits. They are utilized in:

- planning economic utilization of mineral deposits and their exploitation,
- designing mines,
- forecasting possible environmental impact of mining, and planning proper environment protection,
- land use planning on the area of mineral deposits occurrence.

The presented geological data are important for:

- the mine owner and mine holder who expect defined profit from deposit exploitation,
- local society:
  - which has a profit from mining due to varied local fees and taxes paid by mine holder, and through decreasing unemployment,
  - which is affected by unwanted environmental impact of mining,
- national economy:
  - direct, due to general paid taxes,
  - indirect, through promotion of economic activity of mining region and assurance of necessary mineral commodities supply.

Geologist as the author of information used in technical, economic and environmental activity is responsible of their appropriate presentation.

The basic and particular feature of geological information is the mode of their gaining through direct observations of geological phenomena, investigation of collected samples or interpretation of geophysical measurements. Immediate verification of their correctness is limited and often possible only by repetition of appropriate investigations [4]. Therefore utilization of geological data, presented in geological reports and maps, is based on trustworthy to its author, that they are reliable and that presented their interpretation is correct.

Professional geologist should always feel responsible of results of his work presented to the customer or public. It is particularly important, if utilization of results of geological investigations is expected in imprecise future. The possible errors, irreparable, can make presented data not utilizable, or promote wrong actions.

The professional geologist in his work should follow ethical rules [2]. They are based on:

- competency and professionalism – appropriate qualifications gained by specialized education and training, and ability to use the acquired knowledge gained by practical their utilization; this knowledge need to be permanently actualized and improved,
- independency – presentation of own, independent opinions not affected by expected results of realized geological investigations,

- transparency – clear, comprehensive presentation of geological data and interpretations and clear their documentation and explanation,
- objectiveness – honest presentation of observed phenomena, collected data, and results of investigations, as well as reasons and grounds of their interpretation.

Such rules not applied, may give way to not ethical behavior and actions. Following enumerated rules the data and their interpretations presented in geological reports:

- should be reliable, based on all recorded and verifiable data,
- not provoke unjustified, groundless expectations, which fulfillment is uncertain or impossible,
- not create possible threats and unwonted effects of following actions, and to point out possibility of their occurrence,

Such exigencies may be only but partly guaranteed by legal acts as e.g. mining law, which are not sufficient for fulfillment of ethical standards.

Utility of geological report is the main target, even if the customer for whom it is prepared is not aware of it, due to the lack of sufficient his personal knowledge.

The important part of geological information is interpretation of geological data presented as conceptual deposit model visualized on maps and cross sections. The main question in their preparation is the limited possibility to gain full, comprehensive knowledge of studied deposit.

The limited possibility to gain complete knowledge of studied deposit should be always clearly presented. Such is e.g. the assignment of resources and reserves classification. Sub division to hypothetical (D), inferred (C_2) indicated (C_1) and measured (B or A) category is the mode of presentation of confidence in geological data.

Limited knowledge of data and uncertainty as to location and limits of presented or interpreted phenomena should be signalized on maps and cross sections by differentiation of their graphic presentation: solid lines, dashed lines or dashed lines with question mark respectively etc. The level of uncertainty of deposit geological model presented on maps and sections is the basic criteria of evaluation of confidence in resources and reserve evaluation. The formal approach to valuation such confidence as for example through the borehole network density is insufficient.

If presented interpretation of geological data is uncertain, and there is the possibility of varied interpretations, they should be presented [3]. It is important for further planning of mining operations.

Geologist should be also aware of his limited knowledge and limits of his competency. They may be objective or subjective.

Objective it is due to limited geological field data, limited possibility of realization of geological field or laboratory work, due to varied reasons (limited land access, limited funds etc.). Such limitation, and consequently the possible imperfectness of geological interpretations should be clearly presented in geological report.

Subjective limitation, are due to lack of sufficient personal knowledge and training, gained by geological education, and lack of sufficient experience in applying possessed knowledge. It may be source of "errors by ignorance" [5].

Interpretation of geological data on maps and cross sections is also biased by geologists subjective approach, formed by his point of view, knowledge, and former experience. The basic is the consistency of field and laboratory data and their interpretation. However interpretation of geological data is based always on some hypothetical assumptions. The "visionary" approach in such interpretations, not supported by existing, verified data, should be avoided. The caution in geological interpretations and opinions should be indispensable rule.

Planning, project preparation of prospecting and exploration of mineral deposits, reporting and evaluation of results of such works, without sufficient knowledge are not ethical actions.

Delimitation of objective and subjective lack of knowledge and demonstration of "errors of ignorance" is not easy task. Therefore it is indispensable the review of presented reports by independent competent person (or persons).

The basic purpose of geological report is to supply data, necessary to evaluate if mining of explored deposit is possible, and supply the data for feasibility study of mining project.

Feasibility study is possible if the deposit is sufficiently detailed explored and mineral resources demonstrated as indicated at least. The cooperation of geologists with mining engineer responsible for mine designing is obviously indispensable [6,7].

The basic requirement for deposit exploration is to gain the data necessary for designing mining operations. Such data are:

- geological structure of deposit, tectonic features, deposit discontinuity,

- variations of quality of mineral commodity (which can make necessary selective exploitation of different mineral varieties),
- geological conditions of mining: hydro-geological, geo-engineering (geotechnical), gaseous, geothermic.

As additional the possible uncertainty of resources/reserves estimation should be evaluated.

Geological reports are the basic information of national mineral resources potential and of possibility of their utilization. Data presentation, not critical enough as to the uncertainty of presented data, may provoke unjustified expectations on their utility in the future, and on country economic welfare. For example presentation of huge resources as recoverable without sound geologic backgrounds may lead to erroneous economic decision.

Geologist should always be aware of his responsibility for mode of management of geological works and public presentation of their results.

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