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# Determination of mineral location coordinates in geotechnology and mining enterprises

**Ravshanov Zavqiddin Yahyo o'g'li**
Tashkent State Technical University named after Islam Karimov Assistant teacher:
Student of Nukus Mining Institute: **Joldasbayeva Aysulu Baxitbay qizi**
Student of Nukus Mining Institute: **Maulenov Nurlibek Axmet o'g'li**
Student of Nukus Mining Institute: **O'telbayev Azizbek Alisher o'g'li**

**Abstract**: Three types of GDS-based studies, namely studies on mine planning, operation, and environmental management, were examined to describe the role of GDS as a decision-making support tool in mine development. This review was conducted by classifying previous GDS-based studies into several subtopics that pertain to mine development activities and the range of environments to be managed.Geotechnical analysis plays an important role in determining mining method selection. Iron ore body is initially planned to be mined by using long hole mining method. Detailed geotechnical site investigation and laboratory work are carried out to assess the applicability of the selected mining method. Diamond-drilled borehole cores are logged and geotechnical characterization of rock mass units is conducted by assigning RMR89 and Q classification values to the basic rock units. Extensive laboratory test work is carried out to find the geotechnical material properties of the ore and the wall rocks. Based on the results of rock mass classification efforts, empirical stope dimensioning work and detailed numerical (finite element) modeling for the stability analyses of pillar-stope layouts and overall mine are conducted. Finally, it is concluded that planned long hole stope dimensions appear to be unsafe and drift and fill mining method appears to be more suitable for this project.

**Keywords:** Geotechnical research,Mining methods, rock characterization, long hole, drift and fill mining, empirical stope dimensioning, numerical modeling, stability analysis, Geotechnical analysis.

## Introduction

When the natural regional framework discussed above has been established, each rock type at the project site should be subdivided into consistent units or domains based on a combination of the following:
#rock type (lithology);
# mineralisation (ore and waste);
#alteration, including all pre- and post-mineralisation events;
#weathering;
#geomechanical properties.
a) The following clauses of this document outline the minimum geotechnical requirements, which shall be met in the design for all projects. The requirements stipulated here are the minimum geotechnical requirements and do not preclude the Designer from using other proven methods in addition to those identified within this

document. Some construction requirements that may impact the designs are also included.

b) Scope briefing for all geotechnical works shall be acceptable to Transport and Main Roads

Geotechnical Section before the commencement of any geotechnical site investigation. Geotechnical site investigation shall be carried out in accordance with AS 1726 and logging of encountered subsurface materials during geotechnical investigation shall be in accordance with the departmental Guideline on Geotechnical Logging. Where there is a conflict between AS 1726 and this Geotechnical Design Standard (GDS), the content of this GDS shall take precedence.

c) All geotechnical design reports, including drawings, shall be submitted to Transport and Main Roads Geotechnical Section in electronic format (and hard copy if requested) for review. The reports shall state clearly the assumptions, the justification of adopted geotechnical profiles, parameters and the methods adopted in design and address all relevant issues or concerns for the design element in question. The reports shall also include geotechnical long and cross-sections together with the site investigation location plan(s) drawn to the same horizontal scale for each design element.

d) The establishment of a geotechnical model in the context of this document shall generally be in accordance with the requirements of Clause 5.2 of AS 1726. However, for each geotechnical design element, the specific minimum requirements shall be in accordance with the relevant sections below.

e) When the reports are submitted in stages (for example, concept, business case, detailed design stages and so on), each report shall be a standalone report. At the end of the full review process, a final standalone geotechnical report, including geotechnical field and laboratory data, interpretative design report(s) as per Clause 1(c) shall be submitted to Transport and Main Roads Geotechnical Section through the Administrator for their record.

f) The design calculations, duly documented as the design work progresses, shall be provided, on request, to the Administrator. The Administrator shall provide these reports to Transport and Main Roads Geotechnical Section.

The objective of the model is to provide a design-level understanding of the 3D boundaries and the geomechanical attributes that characterise each rock type at the site. When preparing the model it is important to recognise that at many ore bodies the overburden may have an entirely different geology from the ore and the host rock.There can also be thick saprolites above ore bodies in tropical environments. To illustrate the requirement, Figure 1 uses mineralisation and alteration of two different lithologies to define seven basic geological units:

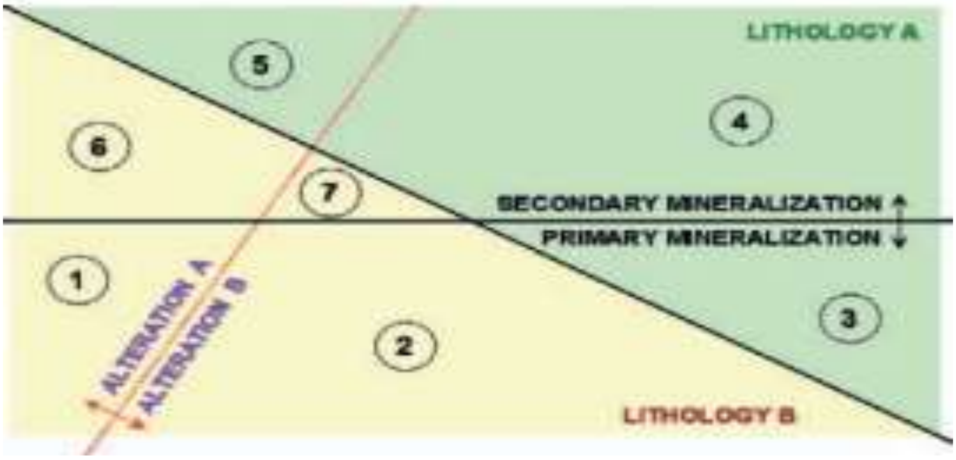


Figure 1: Example of the definition of basic geological units by superimposing the lithology (2 types), the mineralisation (2 types) and the alteration (2 types).

The first step in the model-building process is to compile the entire field mapping data, including core data from subsurface exploration and geotechnical drilling programs, into a geological plan of the pit. This plan is then incorporated into a 3D solid geological model using a modelling system such as Vulcan™, DataMine™, MineSite™ or Surpac™. Mapped data from Autocad is usually imported as DXF files so that the geologist can connect the fault, lithological or other geological boundary traces and build on those traces in 3D to make modelled shapes or triangulations. Once the triangulations are made it is easy to cut them to pit shells or into sections. The complete process is illustrated in Figures 2, using examples from different mine sites.

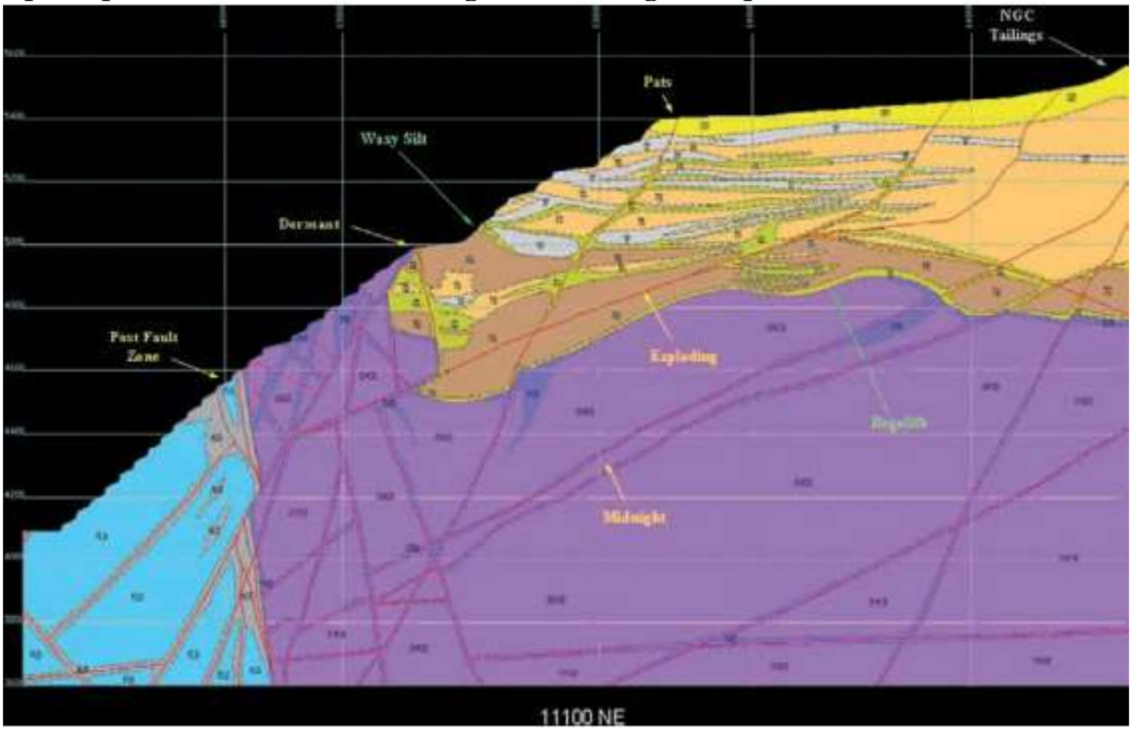


Figure 2.Geological cross-section through the east wall of the Mines Betze-Post open pit.

Figure 2 are from the Goldstrike Mines Betze-Post open pit. Figure2 is a 2001 version of the Goldstrike geological model projected to the open pit shell. Figure 2 is a cross-section through the east wall of the pit. Figure 2 highlights a modelling issue relating to the level of confidence in the geological information shown on the cross-section. Before computer graphics became established in the industry, geological maps and crosssections were hand-drawn. With hand-drawn maps and cross-sections it was standard practice to designate only established or known geological boundaries and structures with solid lines. Uncertain or inferred geological boundaries and structures were shown as dashed lines or as dashed lines with question marks between the dashes. Since the introduction of computer graphics systems this practice has fallen by the wayside and all boundaries are shown as solid lines – in consequence any uncertainty in features such as lithological boundaries and major faults is not reflected in the drawing (plan or section). In Figure 2 the spacing of the horizontal grid lines is 200 feet (c. 61 m). In keeping with this scale, it is reasonable to assume that the geological boundaries shown in the upper 200 feet of the cross-section are based on surface exposure and drill hole intersections and can be regarded as well-established. It is equally likely that the deeper boundaries (e.g. towards the lower right-hand side of the section) are based on projected data rather than on drill hole intersection or other real data. This introduces an element of uncertainty into the reality of their locations, which is not reflected in the solid nature of the boundaries shown on the section.

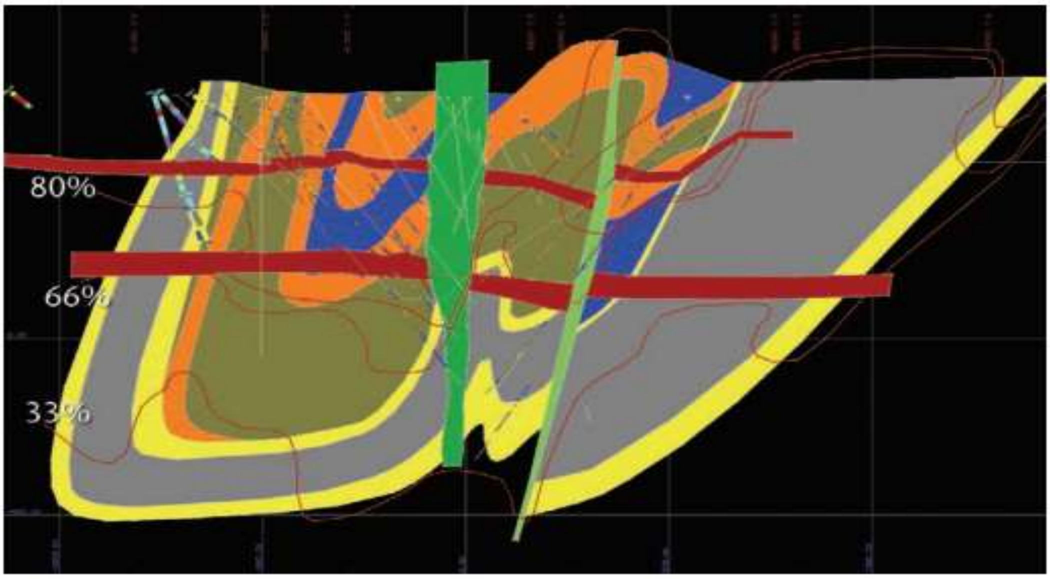


Figure 3: Cross-section S1 showing interpreted stratigraphic and structural boundaries, drill holes and estimated levels of data certainty with depth.

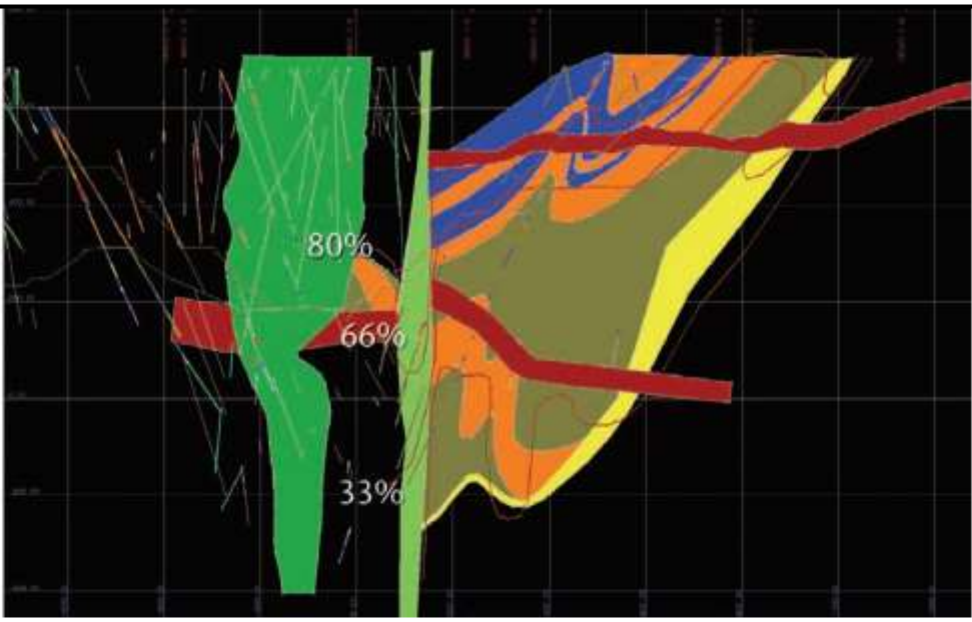


Figure 4.Cross-section S2 showing interpreted stratigraphic and structural boundaries, drill holes and estimated levels of data certainty with depth

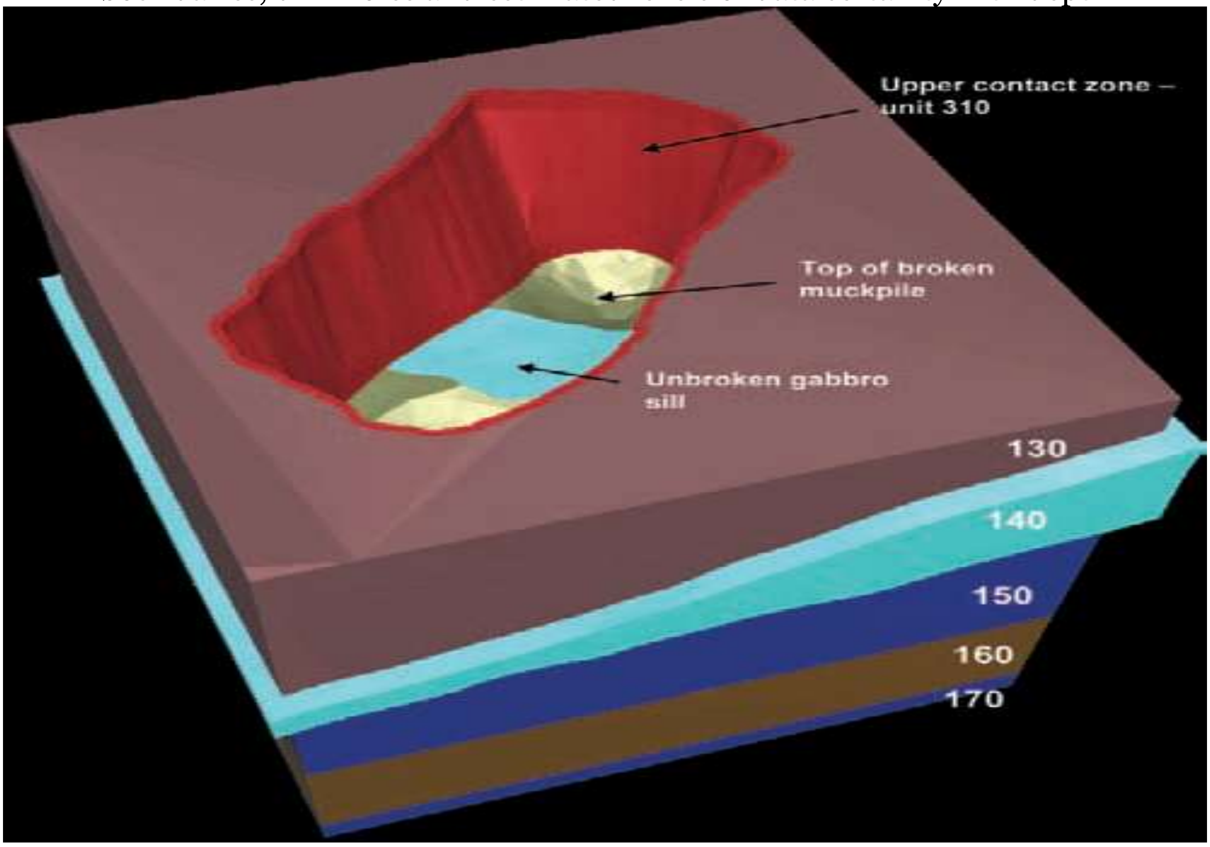


Figure 4: 3D solid model of sedimentary pile showing intrusive gabbro sill and the boundary of the upper contact zone of the intruding kimberlite pipe

## Geotechnical Report

The geotechnical report is the tool used to communicate the site conditions and design and construction recommendations to the roadway design, bridge design, and construction personnel. Site investigations for transportation projects have the objective of providing specific information on subsurface soil, rock, and water conditions. Interpretation of the site investigation information, by a geotechnical engineer, results in design and construction recommendations that should be presented in a project geotechnical report. The importance of preparing an adequate geotechnical report cannot be overstressed. The information contained in this report is referred to often during the design period, construction period, and frequently after completion of the project (resolving claims). Therefore, the report should be as clear, concise, and accurate. Both an adequate site investigation and a comprehensive geotechnical report are necessary to construct a safe, cost-effective project. Engineers need these reports to conduct an adequate review of geotechnical related features, e.g., earthwork and foundations. The State or their consultant should prepare “Preliminary” geotechnical reports for submittal to the design team whenever this information will benefit the design process. Early submittal of geotechnical information and recommendations or engineering evaluation of preliminary data may be necessary to establish basic design concepts or design criteria. This is commonly the case on large projects or projects containing complex or difficult geotechnical problems where alignment and/or grade changes may be appropriate based on geotechnical recommendations. The development of a “Final” geotechnical report will not normally be completed until design has progressed to the point where specific recommendations can be made for all of the geotechnical aspects of the work. Final alignment, grade, and geometry will usually have been selected prior to issuance of the final geotechnical report.

## Conclusions

In summary, today, the mining of mineral resources directly affects the national economic development, to be able to do a good job in geological and mineral mining requires adequate geological exploration and reasonable application of mineral search technology to ensure that the mineral exploration work can meet the needs of modern development. Remote sensing technology plays a very important role in many fields, and the application of this technology in geological exploration has greatly promoted the development of geological exploration work in Uzbekistan. The scientific use of modern information imaging technology can provide good conditions and greater convenience for geological exploration and geological prospecting work. Remote sensing technology in geological prospecting can significantly improve the comprehensive level of geological exploration, strengthen the accuracy of geological prospecting based on advanced technology, and thus promote the smooth development of geological exploration and prospecting work in Uzbekistan. We create a drilling database management system to manage geological drilling data scientifically and release geological drilling information and drilling dynamics in real time to provide users with a convenient and fast data sharing channel and provide early warning service of geological disasters for coalfield exploration and development. In the specific survey, it is necessary to clarify the geological landscape, collect relevant information comprehensively, improve the accuracy of geological survey, and ensure that it is carried out to a high standard. Mineral exploration enterprises should also actively introduce advanced technology and equipment to fundamentally improve the efficiency of geological and mineral exploration and mineral search

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