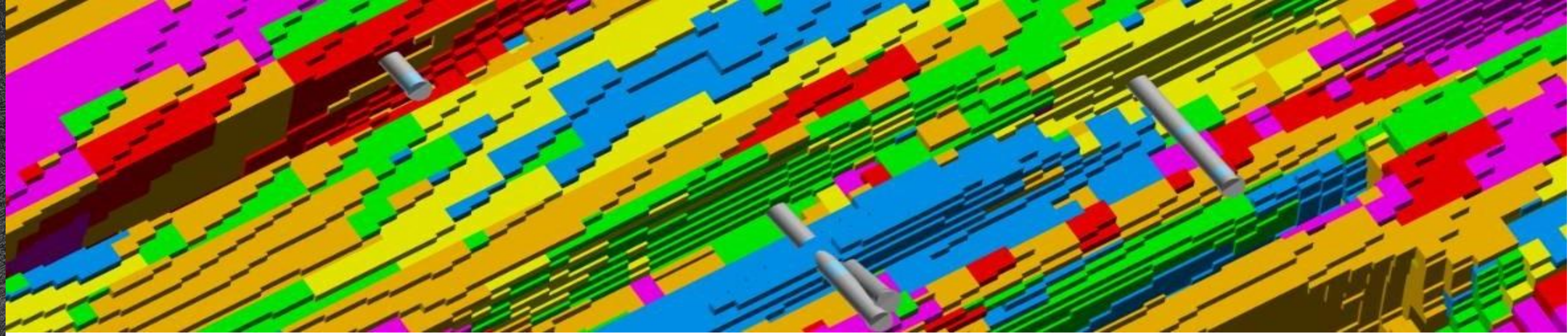
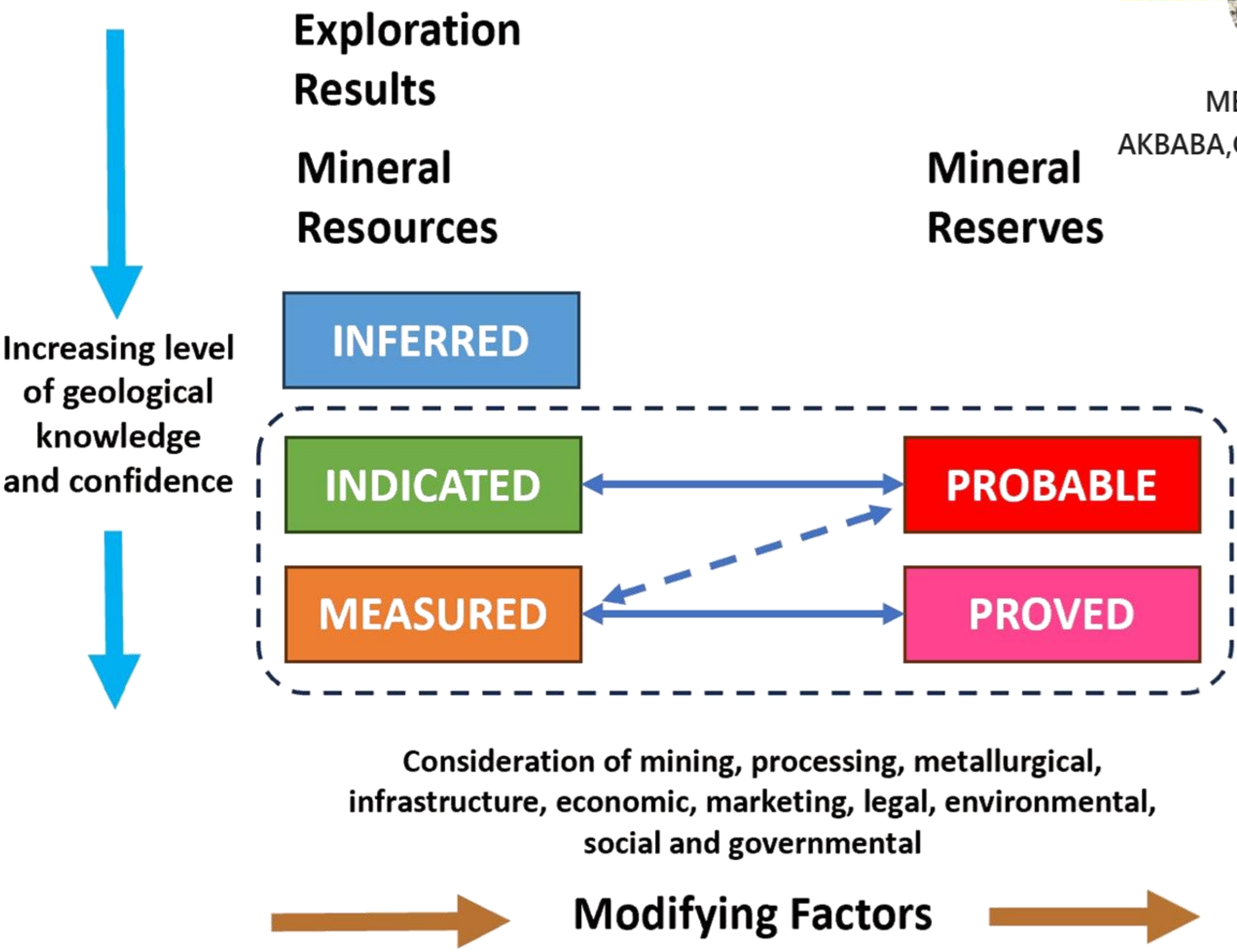
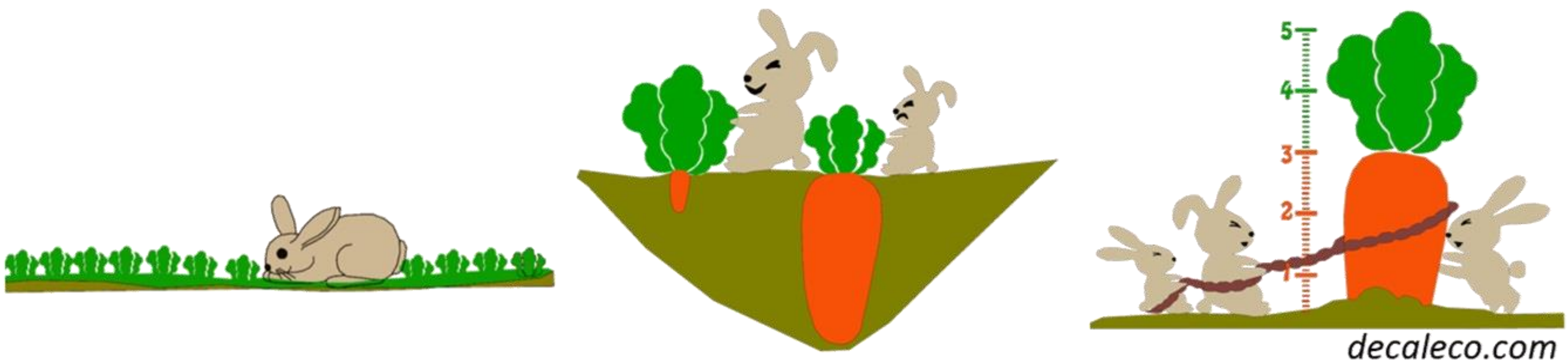


Resource Geologist

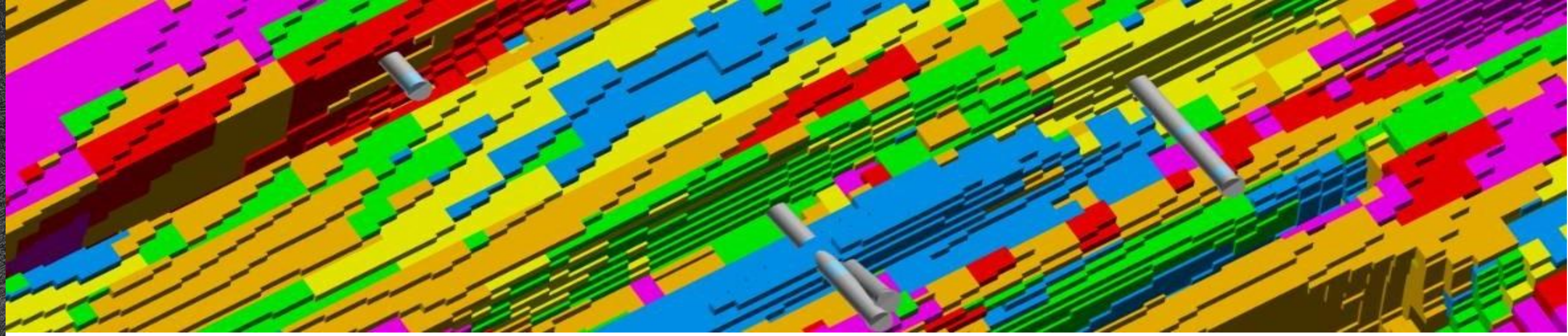
Public Group

MEHMET ALİ
AKBABA,QP,CPG (Geology)





INFERRED INDICATED MEASURED



Resource Geologist

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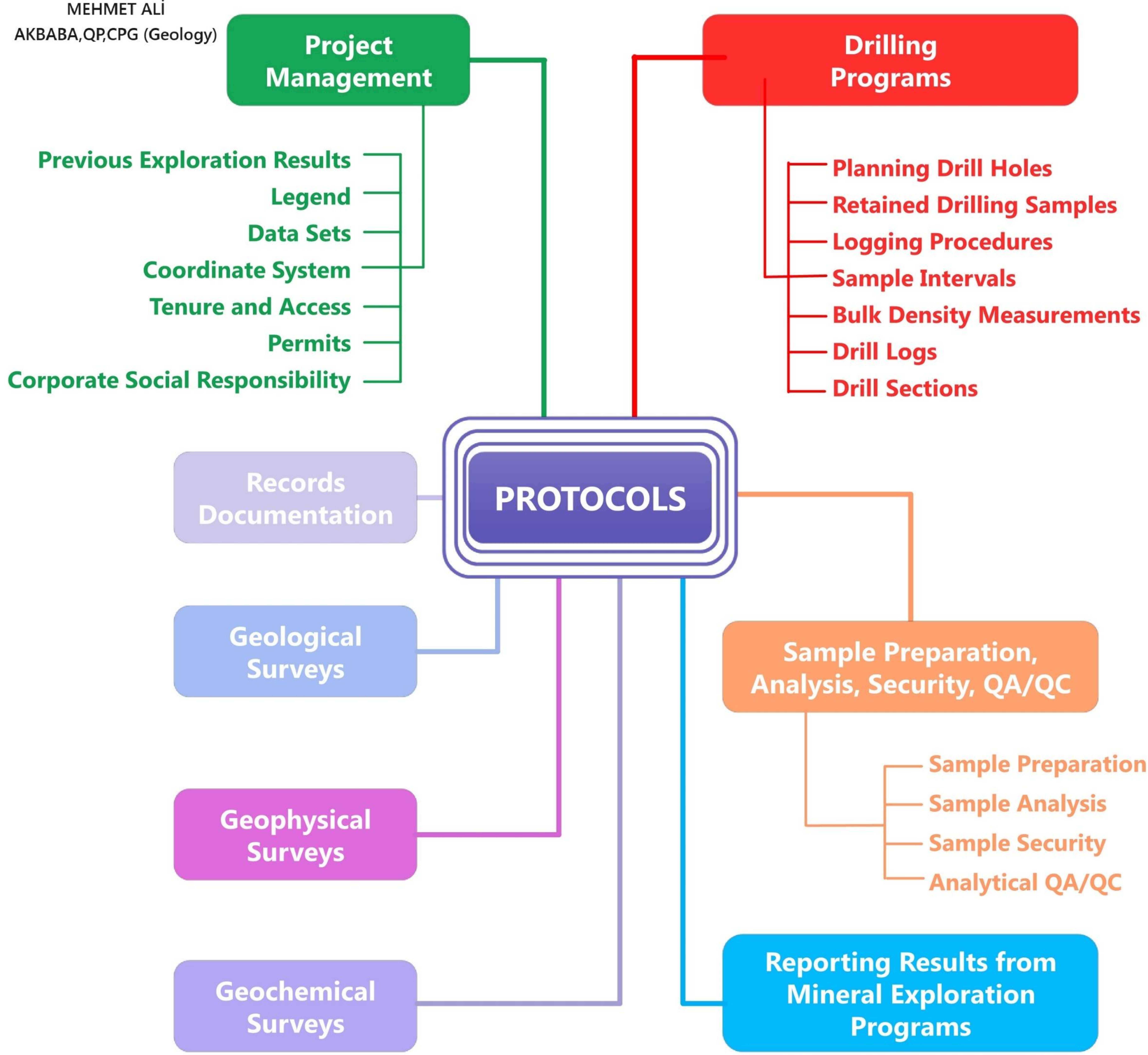
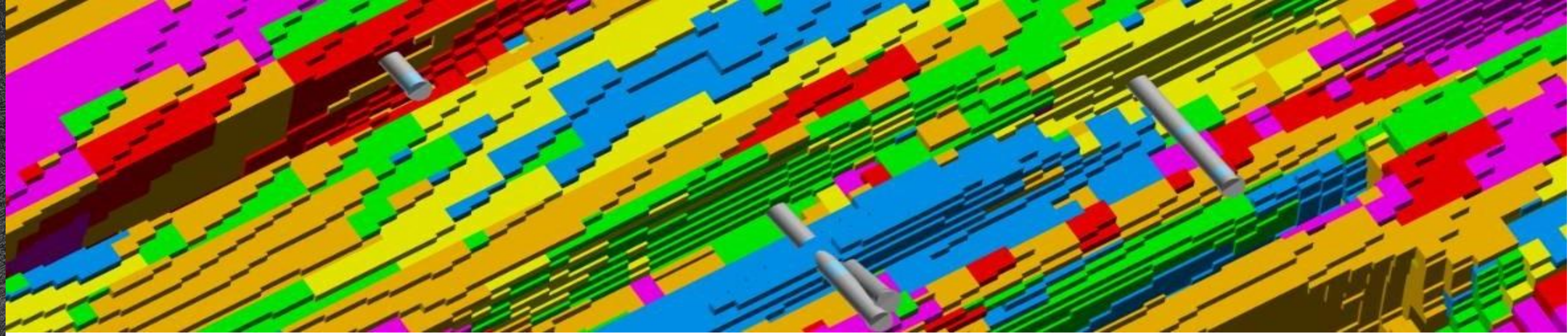
MEHMET ALİ AKBABA,QP,CPG (Geology)

CLASSIFICATION OF MINERAL RESOURCES

DATA QUALITY AND SECURITY (PROTOCOLS)



It has been designed based on the CIM Mineral Exploration Best Practice Guidelines.



Resource Geologist

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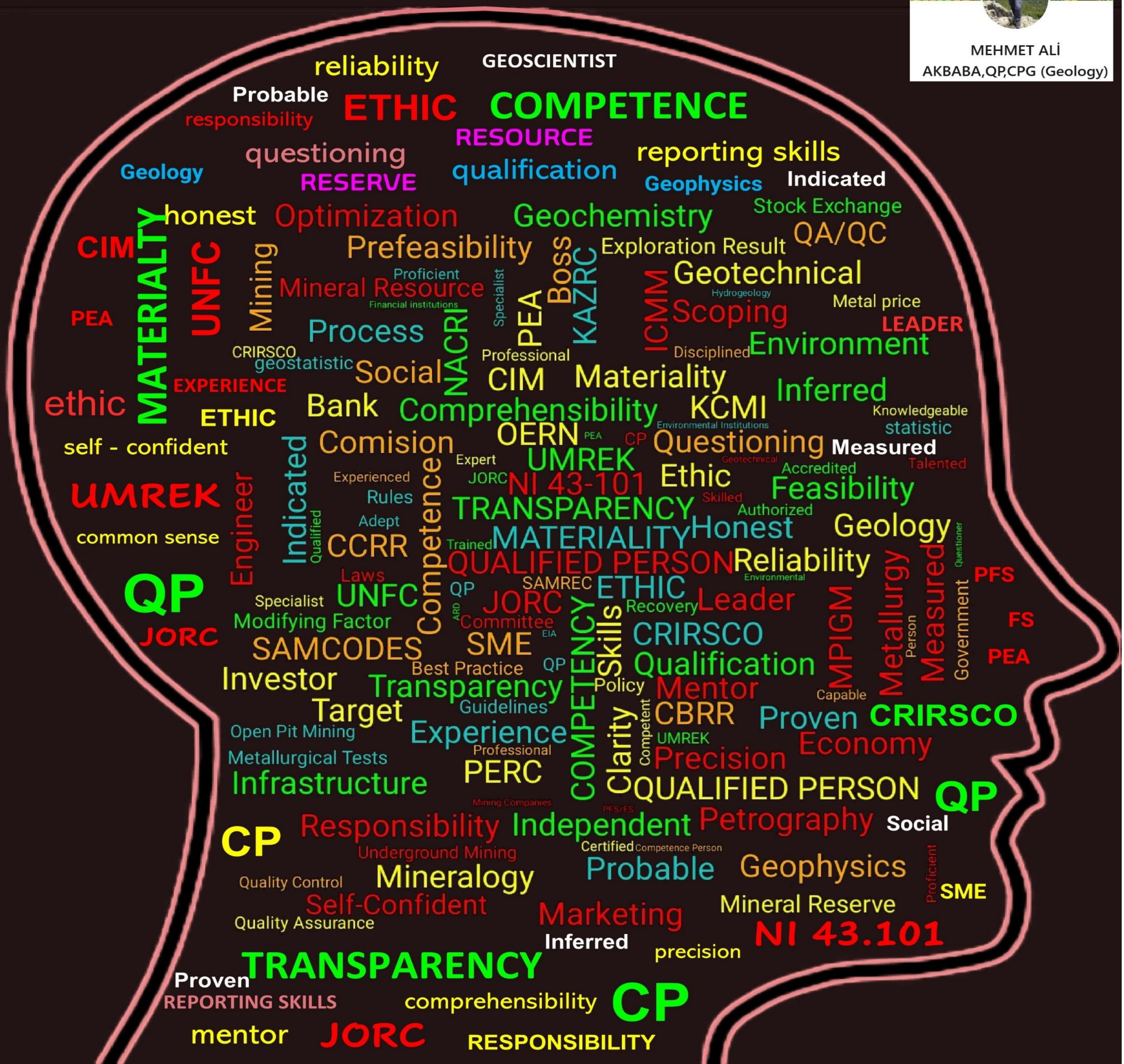
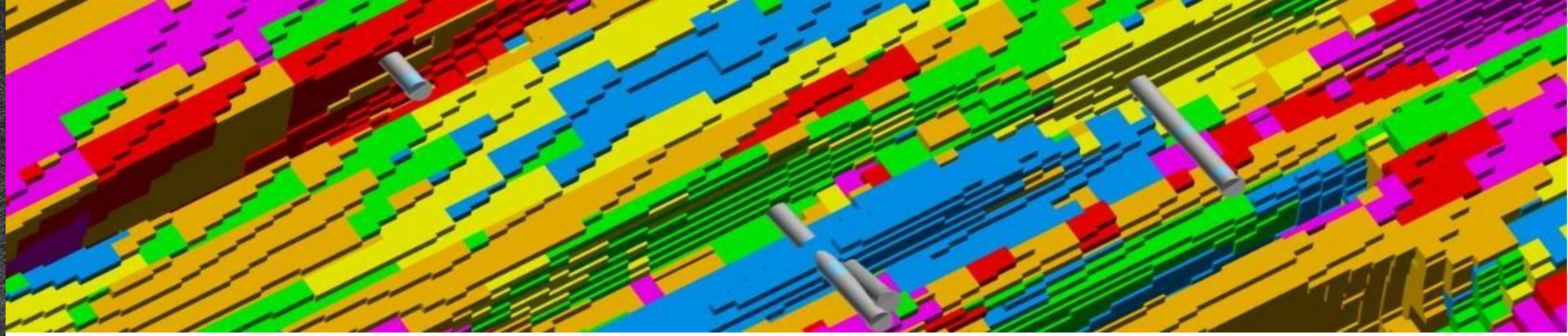
CLASSIFICATION OF MINERAL RESOURCES

QUALIFED PERSON (QP)

MEHMET ALİ
AKBABA,QP,CPG (Geology)





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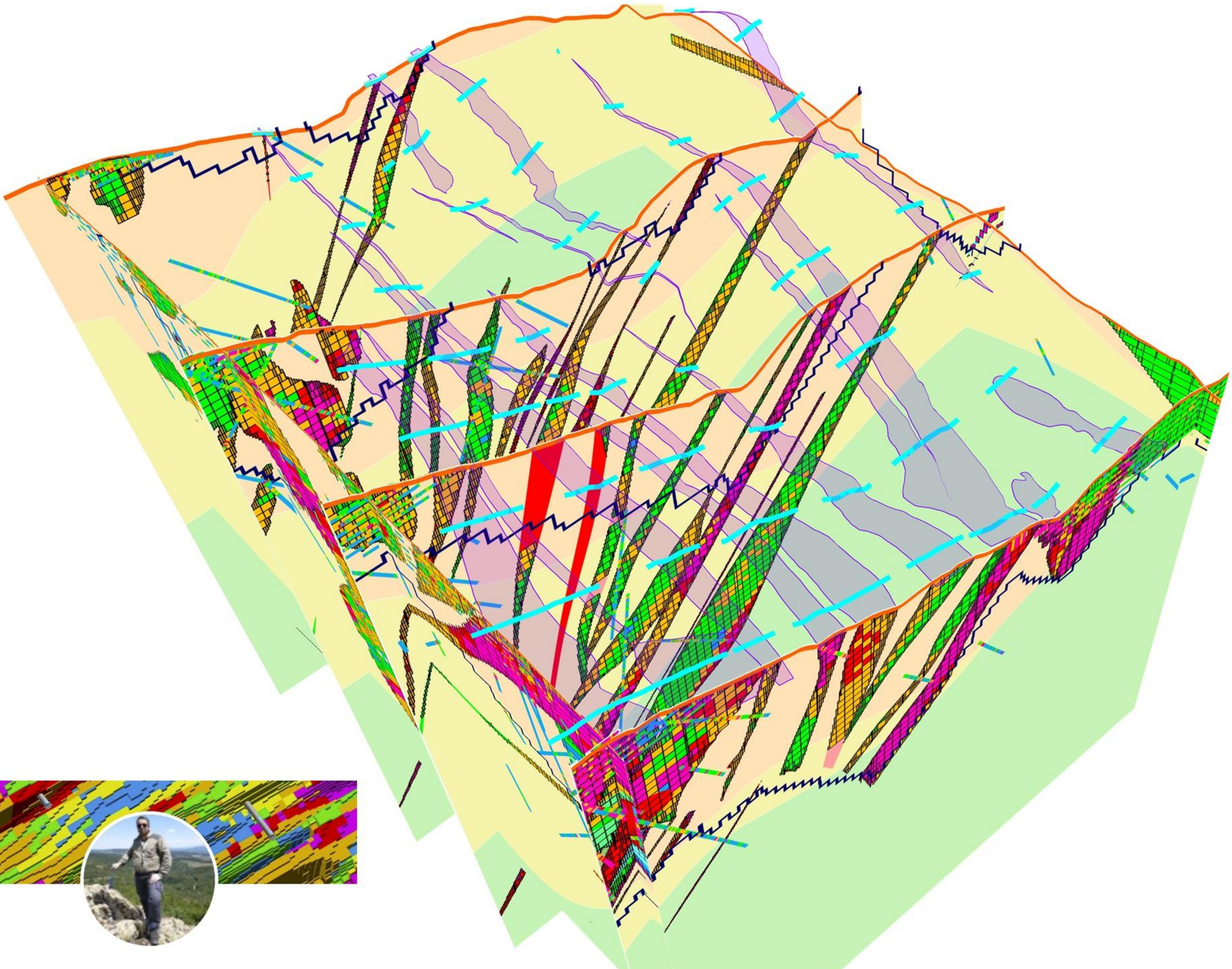
CLASSIFICATION OF MINERAL RESOURCES

DATA DENSITY



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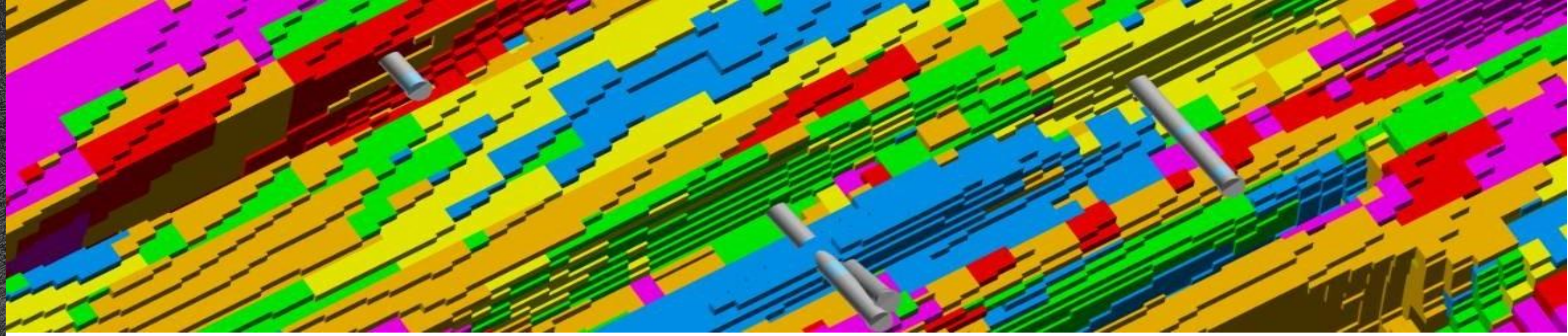
AKBABA,QP,CPG (Geology)



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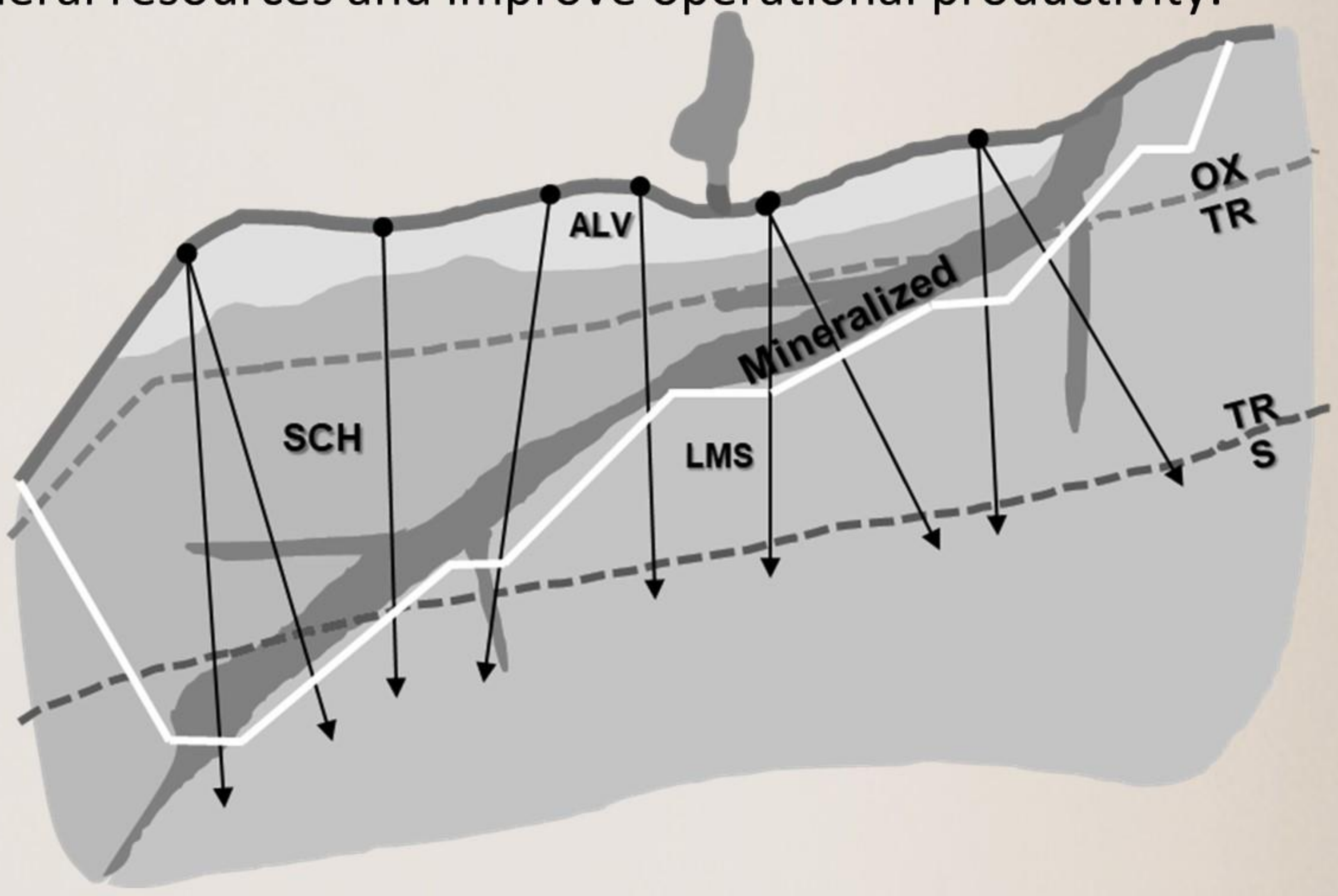
CLASSIFICATION OF MINERAL RESOURCES

MINERAL PROCESSING AND METALLURGICAL TESTING

Geometallurgical Domain: Enhancing Mining Efficiency

Determining the geometallurgical domain is a process where the geological, metallurgical, and economic characteristics of ores and minerals are analyzed. This field assists the mining industry in making strategic decisions to enhance the efficient utilization of mineral resources and improve operational productivity.



Designing Geometallurgical Sample Selection

Geometallurgical sample selection plays a crucial role in the characterization of mineral deposits and the optimization of metallurgical processes. This process requires careful planning and strategy to ensure accurate representativeness and obtain valuable data.

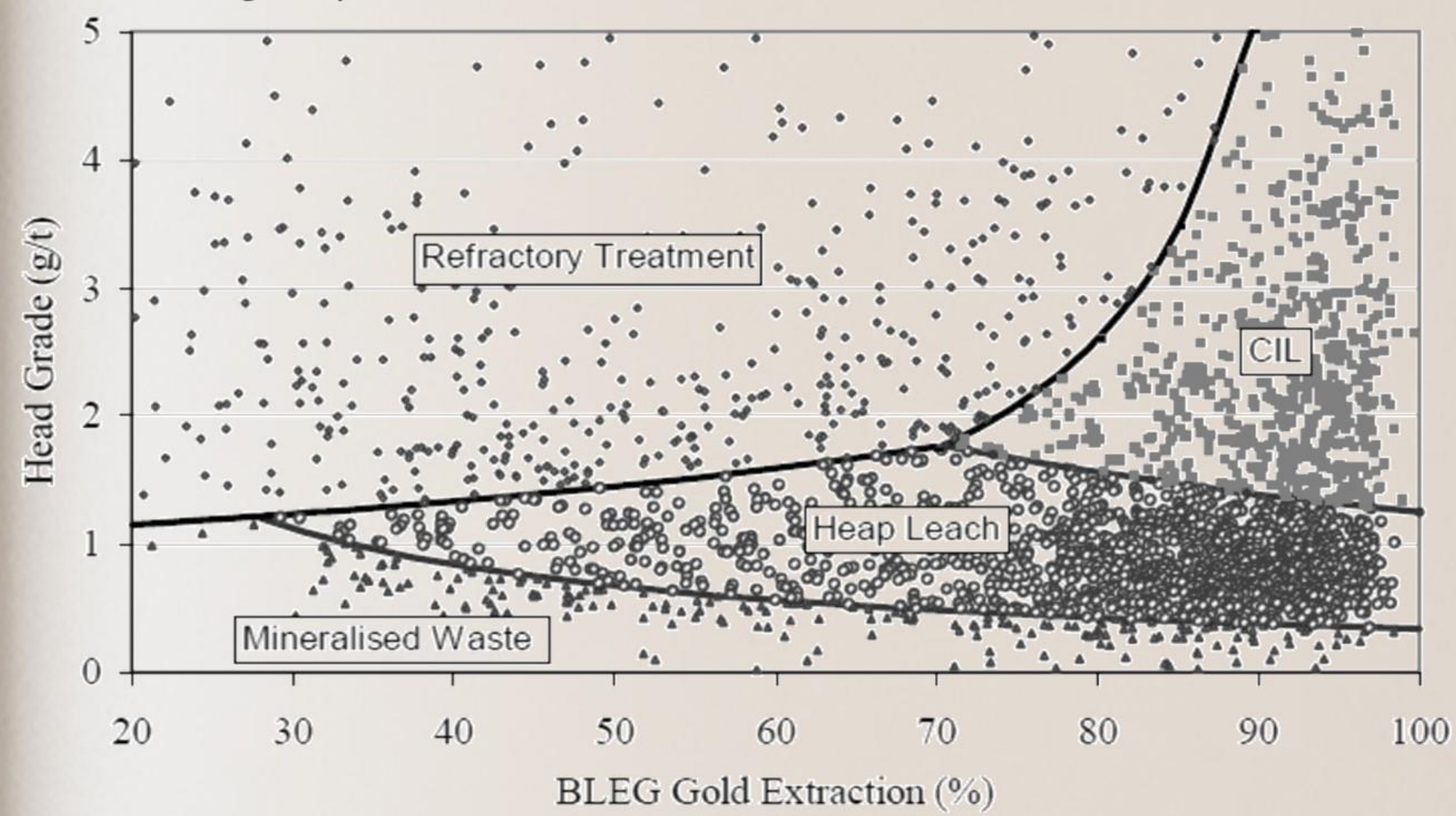
Domain	Redox	Tonnage distribution (%)		Gold Grade g/t
Schist	Oxide	5%	10%	1.5
	Transitional	75%		2.3
	Sulphide	20%		2.4
Contact	Oxide	10%	75%	2.6
	Transitional	60%		2.8
	Sulphide	30%		3.2
Limestone	Oxide	5%	15%	1.8
	Transitional	65%		1.9
	Sulphide	30%		2.2

Geometallurgical Sample Collection: Ensuring Representative Data

Geometallurgical sample collection is a crucial process for understanding and assessing mining fields. To ensure the representativeness and reliability of data, it is vital to carefully select and extract samples from well-chosen and properly cleaned areas using appropriate methods.

Selecting and Subjecting to Appropriate Metallurgical Tests

Choosing the right metallurgical tests is a crucial step in the characterization of ore minerals and determining suitable processing methods. These tests analyze the physical and chemical properties of ores, assisting in the design of the most efficient and cost-effective metallurgical processes.



McNab B., Exploring HPGR Technology For Heap Leaching of Fresh Rock Gold Ores, IIR Crushing & Grinding Conference (2006), Townsville, Australia, March 29–30.

Optimizing Process Selection and Developing Process Flow Diagrams from Test Results

After conducting tests on the samples, the appropriate process for extracting valuable minerals is determined, and process flow diagrams are developed accordingly. These steps are crucial in designing efficient and effective metallurgical processes for mining operations.

Process Cost Estimation Following Current Price Analysis and Market Exploration

After conducting a thorough analysis of current market prices and exploring potential markets, an estimation of process costs is carried out. This crucial step helps in making informed decisions and developing effective strategies for cost-effective production and competitive pricing.

The Impacts of Mineral Processing and Metallurgical Testing on Mineral Resource Estimation

Mineral processing and metallurgical testing have significant effects on mineral resource estimation. Through these studies, crucial data is obtained, enabling accurate assessments of mineral deposits and facilitating efficient resource management and extraction strategies.

MEHMET ALİ
AKBABA,QP,CPG (Geology)

Uluslararası Katılımlı 75. Türkiye Jeoloji Kurultayı
10-14 Nisan 2023, Ankara, Türkiye
75th Geological Congress of Türkiye with International Participation
April 10-14, 2023, Ankara, Türkiye

75 Türkiye Jeoloji Kurultayı
Geological Congress of Türkiye

CRIRSCO Uyumlu Raporlama Standartlarına Göre Maden Kaynaklarının Sınıflandırılması

Classification of Mineral Resources According to CRIRSCO Compliant Reporting Standards

Mehmet Ali Akbaba

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Öz

Maden Kaynakları Sınıflandırması, teknolojinin gelişimi ve sektörel ihtiyaçların yönlendirmesiyle yaklaşık yüzyıllık bir evrim sonunda CRIRSCO (Maden Rezervleri Uluslararası Raporlama Standartları Komitesi) Komitesi tarafından uluslararası ölçekte bir standardizasyona kavuşturulmuştur. Bu standartlar, 2016 yılında CRIRSCO çatısı altında kurulan Ulusal Maden Kaynak ve Rezerv Raporlama Komisyonu'nun (UMREK) 2018 yılında yayımladığı ilk UMREK kodu versiyonu ile Türkiye'de de uygulanmaya başlanmıştır.

CRIRSCO uyumlu düzenlemeler, sınıflandırma için genel rehberlik sağlar, ancak bu kriterlerin Maden Kaynaklarının ve Rezervlerinin raporlanmasına özel olarak uygulanması, Yetkin Kişinin takdirine bırakılmıştır. Maden Kaynaklarının sınıflandırılması, Yetkin Kişinin tahmine olan güvenini yansıtır.

Tahmin edilen Maden Kaynakları, azalan belirsizlik derecesine göre, Ölçülmüş, Belirlenmiş ve Potansiyel Maden Kaynakları olmak üzere üç sınıfa ayrılmaktadır. Bu sınıflandırmada göz önüne alınması gereken ölçütler başlıca; 1-veri kalitesi ve güvenliği, 2-veri yoğunluğu, 3-jeolojik ve tenör devamlılığıdır. Veri kalitesi ve güvenirliği olarak göz önünde bulundurulması gereken parametreler şu şekilde özetlenebilir: (1) uygun hassasiyette topografik harita ve ölçümler, (2) mineralizasyonun jeolojik konumunu, alterasyonlarını ve yapısal özeliklerini gösteren uygun ölçekli jeoloji haritası, jeokimyasal-jeofiziksel anomali haritaları, (3) en iyi uygulama standartlarını karşılayan KG/KK protokolleri, (4) kuyu ağzı hassas koordinat ölçümleri, (5) kuyu içi sapma ölçümleri, (6) sondaj karotlarının, ters dolaşımlı sondaj kırıntılarının, kırılmış ve öğütülmüş şahit numunelerin muhafazası, (7) yerinde yoğunluk ölçümleri, (8) karot randımanları, örnek aralığı randımanı ve RQD ölçümleri, (9) laboratuvarlar arası kontrol analizleri.

Sınıflandırmada göz önünde bulundurulması gereken diğer parametreler Kanada Maden, Metalürji ve Petrol Enstitüsü (CIM) en iyi endüstri uygulamalarında (2019) belirtildiği gibi şu şekildedir; (1) belirli bir kaynak bloğunun tenörünün ve tonajının tahmininde kullanılan veri noktalarının sayısı ve konfigürasyonu, (2) kullanılan sondaj ve kompozit sayısı, (3) belirli bir bloğun tahmininde kullanılan tahmin seferi ve kabuller, (4) blok tahminlerinin kriging varyansı ve standart sapması, (5) tahmin edilen blok tenörü ile gerçek blok tenörünün regresyon eğimi, (6) seçilen variogram modelinin etki mesafesine kıyasla veri noktalarına olan relatif mesafesi, (7) tenor ve tonaj tahmininin relatif güvenirliğinin değerlendirilmesi, yani jeoistatistiksel sondaj aralığı analizi, (8) bloktan en yakın sondaja olan mesafe, (9) sondajların bloğa ortalama mesafesi. Yukarıdaki sayısal tabanlı parametrelere ek olarak, sınıflamada tüm girdi verilerinin göreli güvenirliğini de dikkate almak gerekir. Bu kapsamda; (1) sondaj verilerinin güvenilirliği, (2) jeolojik ve tenör devamlılığının, jeolojik yorum ve modellemenin, yapısal yorumlamanın ve analiz veri tabanının güvenilirliği veya kalitesi, (3) son tahlilde ekonomik işletilebilirlik için makul beklenti ve eşik değerlerin değerlendirmesi için kullanılan girdilerin güvenirliği, (4) yasal ve arazi mülkiyeti ile ilgili kısıtlamaları göz önünde bulundurulması gerekmektedir.

Uluslararası raporlama standartları ayrıca, madencilik, metalürjik, ekonomik, sosyal ve yasal faktörleri dikkate alarak maden kaynaklarının son tahlilde ekonomik olarak çıkarılabilir olabilecekleri yönünde makul beklenti uyandırabilecek şekilde, tenör veya kalite ve miktarda olmalarını gerektirir. Bu faktörlerde değişiklikler meydana geldiğinde, kaynak tahminlerinin buna göre yenilenmesi gerekir.

Anahtar Kelimeler: CRIRSCO, Maden Kaynakları, sınıflandırma UMREK, Yetkin Kişi

Abstract

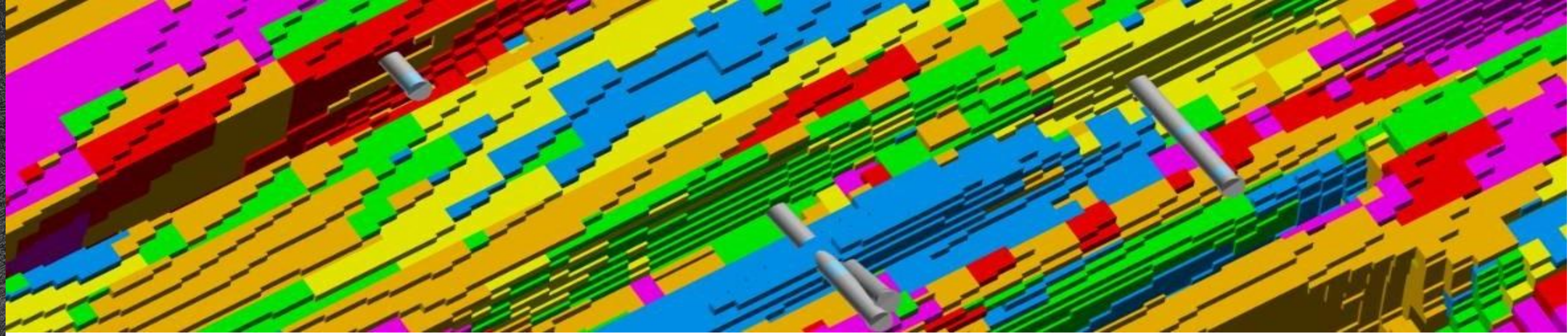
The Mineral Resources Classification criteria has attained an international standard through the works of The Committee for Mineral Reserves International Reporting Standards (CRIRSCO), after nearly a century of evolution, driven by technological developments of and sectoral needs. These standards started to be implemented in Türkiye with the first UMREK code version published in 2018 by National Resources and Reserves Reporting Committee (UMREK), which was established under the umbrella of CRIRSCO in 2016. CRIRSCO compliant regulations provide general guidance for classification, but the specific application of these criteria to the reporting of Mineral Resources and Reserves is left to the discretion of the Competent Person. The classification of Mineral Resources reflects the Competent Person's confidence in the forecast.

Estimated Mineral Resources are divided into three categories according to the increasing and decreasing degree of uncertainty: Measured, Indicated, and Inferred Mineral Resources. The main criteria to be considered in this classification are; 1-data quality and security, 2-data density, 3-geological and grade continuity. The parameters to be considered as data quality and reliability can be summarized as follows: (1) accurate topographic map and surveys, (2) geological maps at appropriate scale showing the geological settings, alterations and structural features of the mineralization, and geochemical-geophysical anomaly maps, (3) QA/QC protocols meeting the best practices (4) collar surveys, (5) downhole surveys, (6) keeping the drilling cores, RC chips, rejects, pulps, (7) measurements Specific gravity, (8) core and sample interval recovery and RQD, (9) umpire analysis.

Other parameters to consider in classification, as outlined in Canadian Institute of Mining, Metallurgical and Petroleum (CIM) industry best practices (2019), are as follows; (1) the number of data points used for estimating the grade or value of a given block, (2) the number of drill holes or drill hole composites used, (3) the estimation pass and underlying assumptions used to estimate a given block, (4) the kriging variance or standard deviation of the block estimates, (5) the slope of regression of the "true" block grade on the "estimated" block grade, (6) the relative distance from a data point based on the range of the selected variogram model, (7) the assessment of relative confidence in grade / tonnage estimation, i.e., geostatistical drill hole spacing studies, (8) proximity to nearest drill hole, (9) average distance to drill holes. In addition to the numerical-based parameters above, it is necessary to consider the relative reliability of all input data in classification. In this context, it is necessary to consider the following points the; (1) the reliability of the drilling data, (2) reliability or certainty of the geological and grade continuity, geological model interpretation, structural interpretation, and the assay database, (3) reliability of inputs to assess reasonable prospects of eventual economic extraction and cut-offs, (4) legal restrictions and restrictions on land tenure.

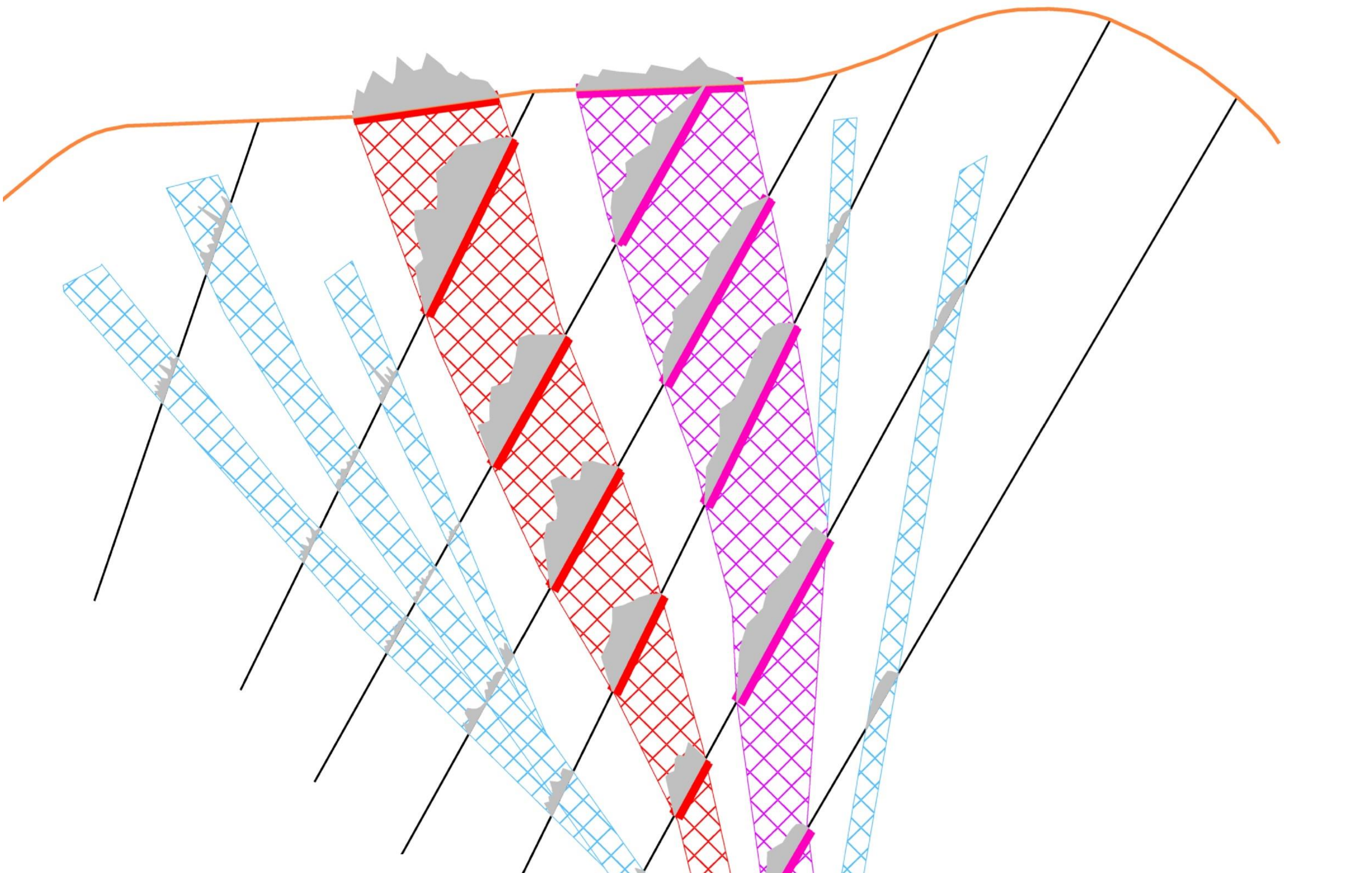
International reporting standards also require mineral resources to be in the form, grade or quality and quantity that may lead to reasonable expectations for ultimate economic viability, taking into account mining, metallurgical, economic, social and legal factors. When changes in these factors occur, resource estimates need to be revised accordingly.

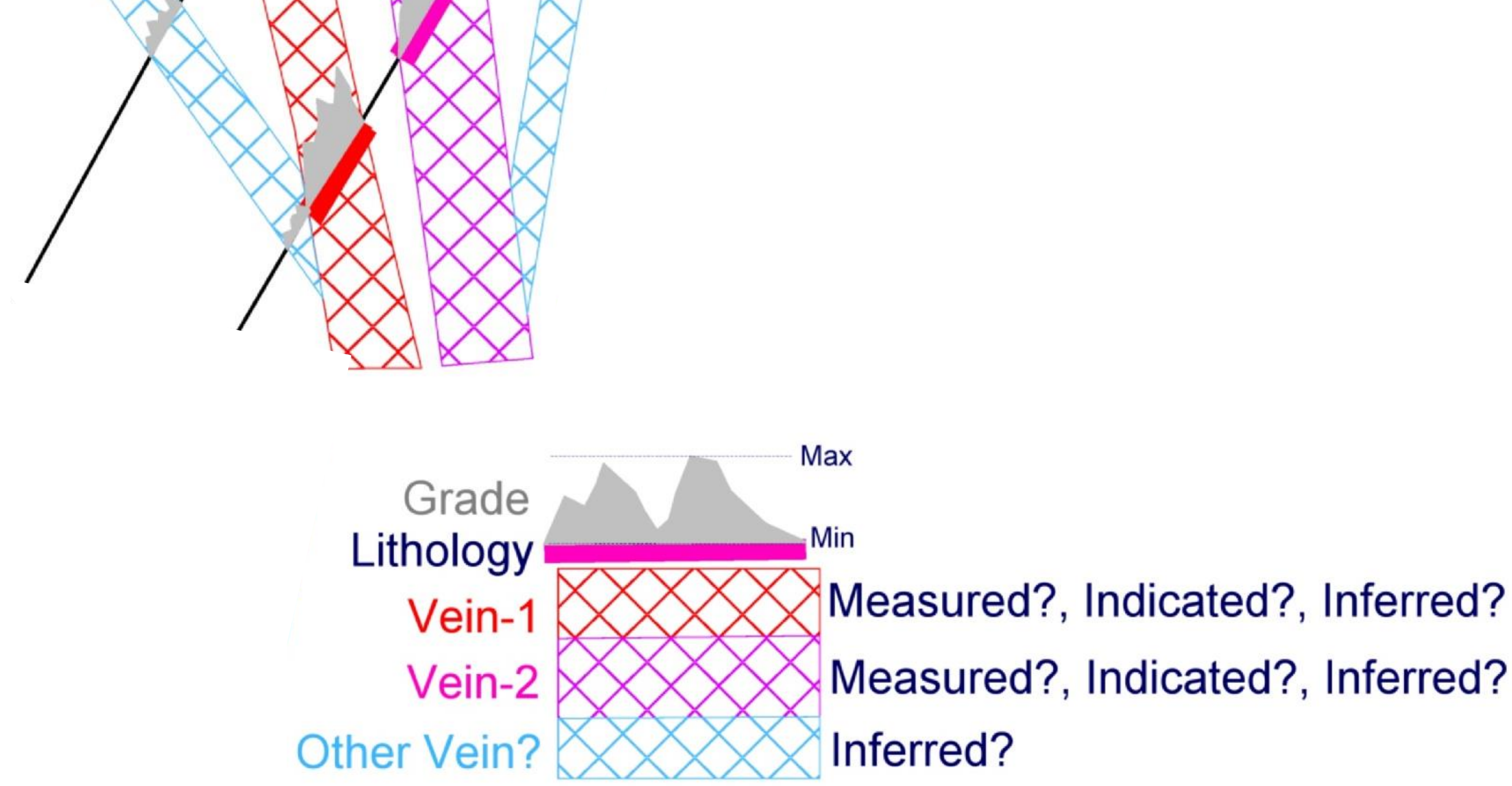
Keywords: *Classification, Competent Person, CRIRSCO, Mineral Resources, UMREK*



Resource Geologist
Public Group

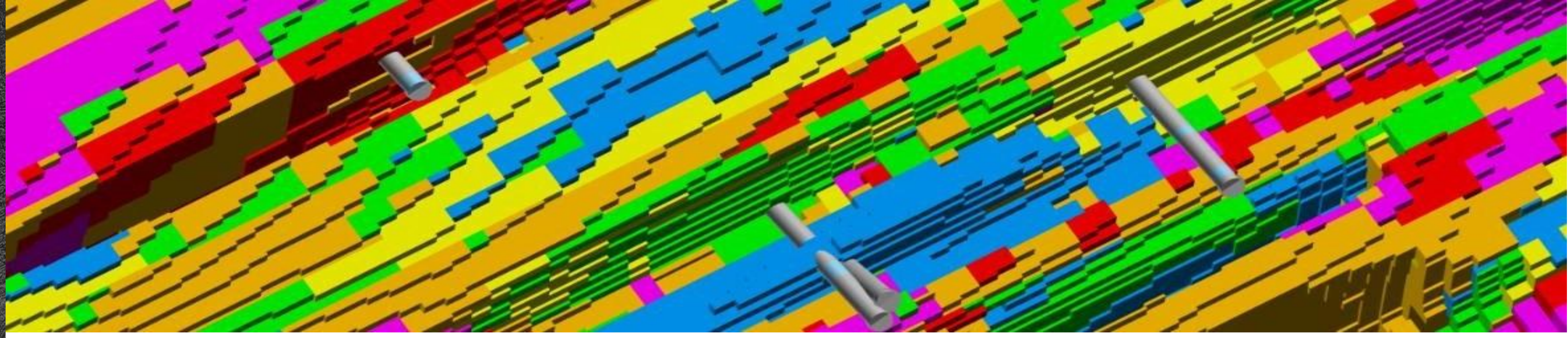
CLASSIFICATION OF MINERAL RESOURCES
GEOLOGICAL CONTINUITY





MEHMET ALİ
AKBABA,QP,CPG (Geology)

RESOURCE GEOLOGIST



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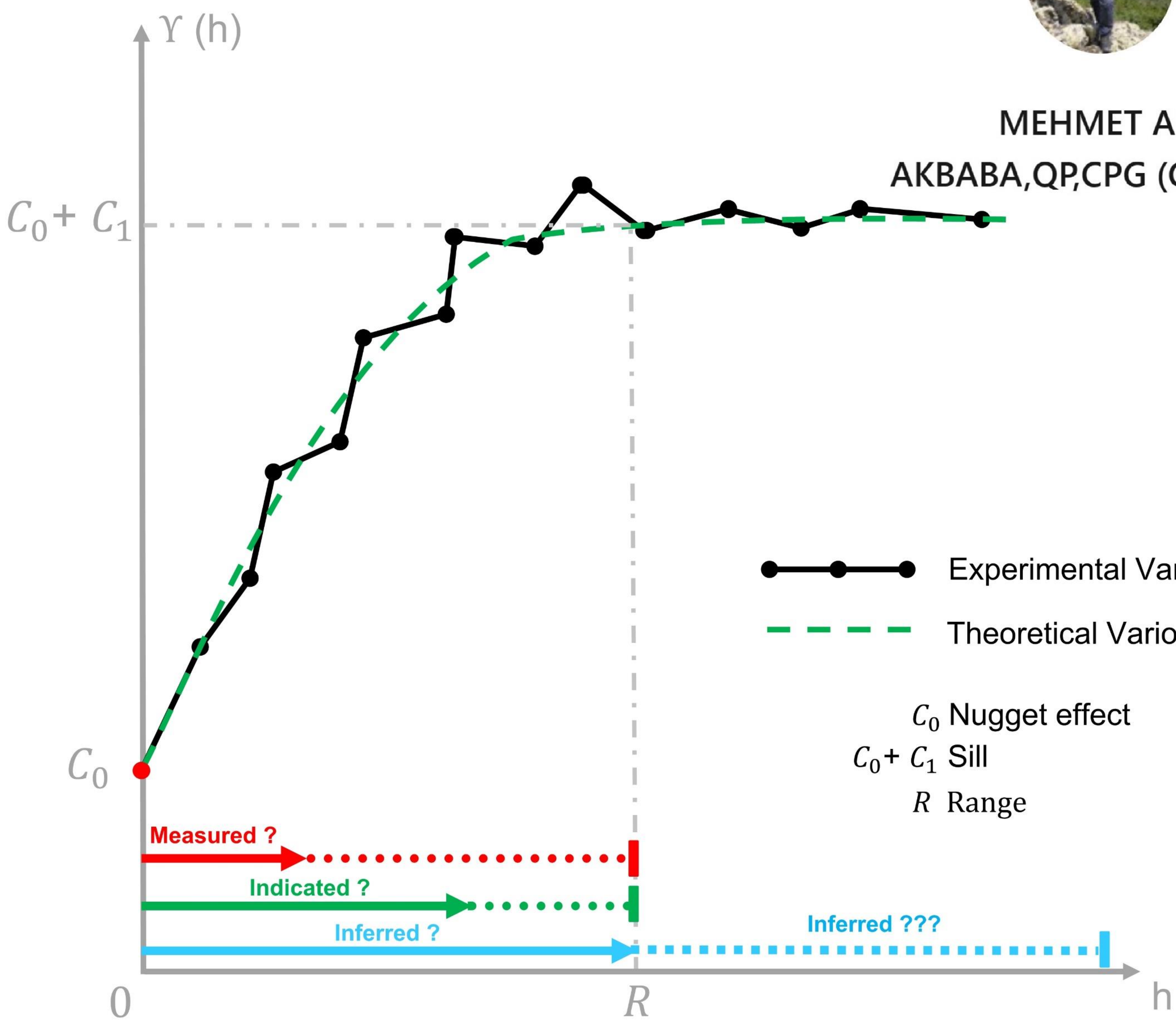
CLASSIFICATION OF MINERAL RESOURCES

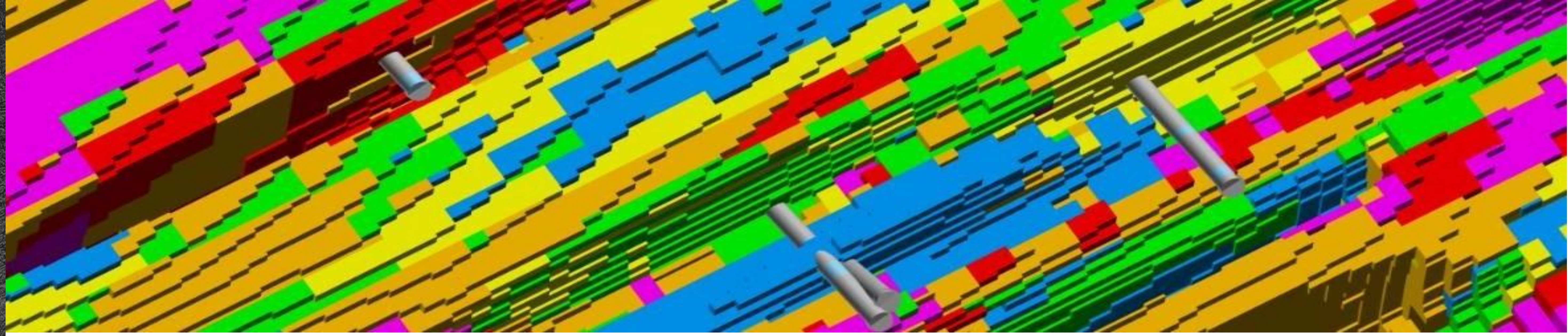
GRADE CONTINUITY

MEHMET ALİ

AKBABA,QP,CPG (Geology)



Note: Inspired by the concept from page 196 of the book "Mineral Deposit Evaluation: A Practical Approach" by Alwyn E. Annels, published in 1991



Resource Geologist

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CLASSIFICATION OF MINERAL RESOURCES

(De-clustering and Search Strategy)

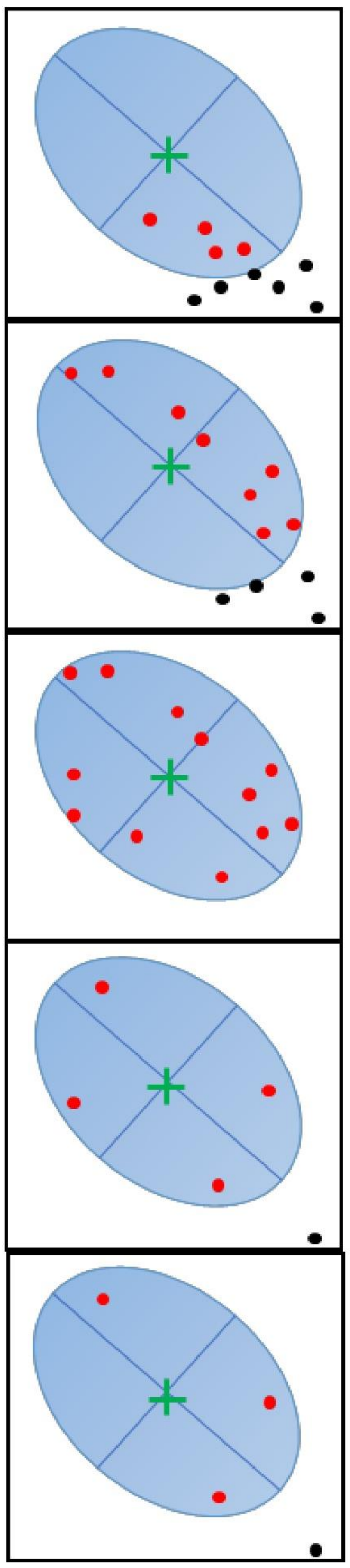
4 composite but single sector
Inferred

8 composite and two sector.
Indicated?

12 composite and four sector.
Measured?

4 composite and four sector.
Indicated?

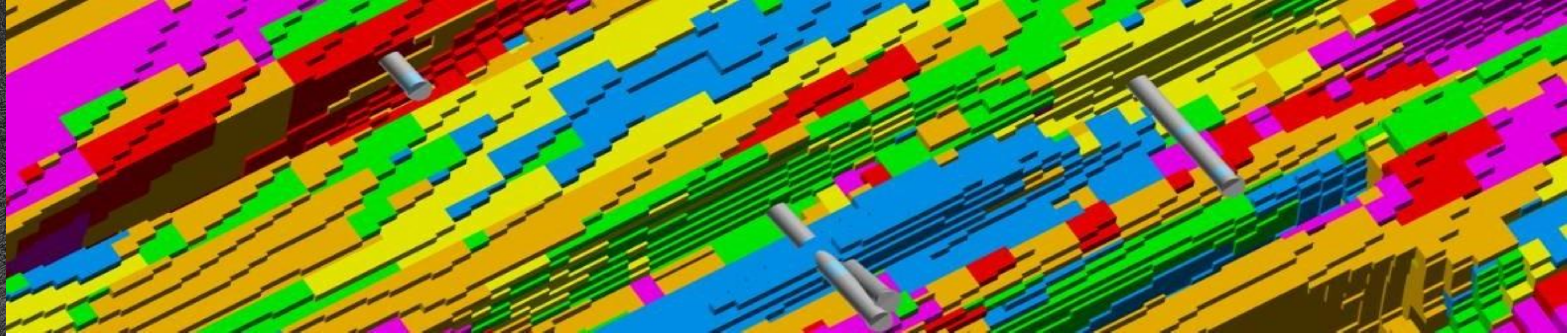
3 composite and three sector.
Inferred



MEHMET ALİ
AKBABA,QP,CPG (Geology)

Explanation

- Block
- Composite not used in interpolation
- Composite used in interpolation
- Search Ellipsoid
- Block center



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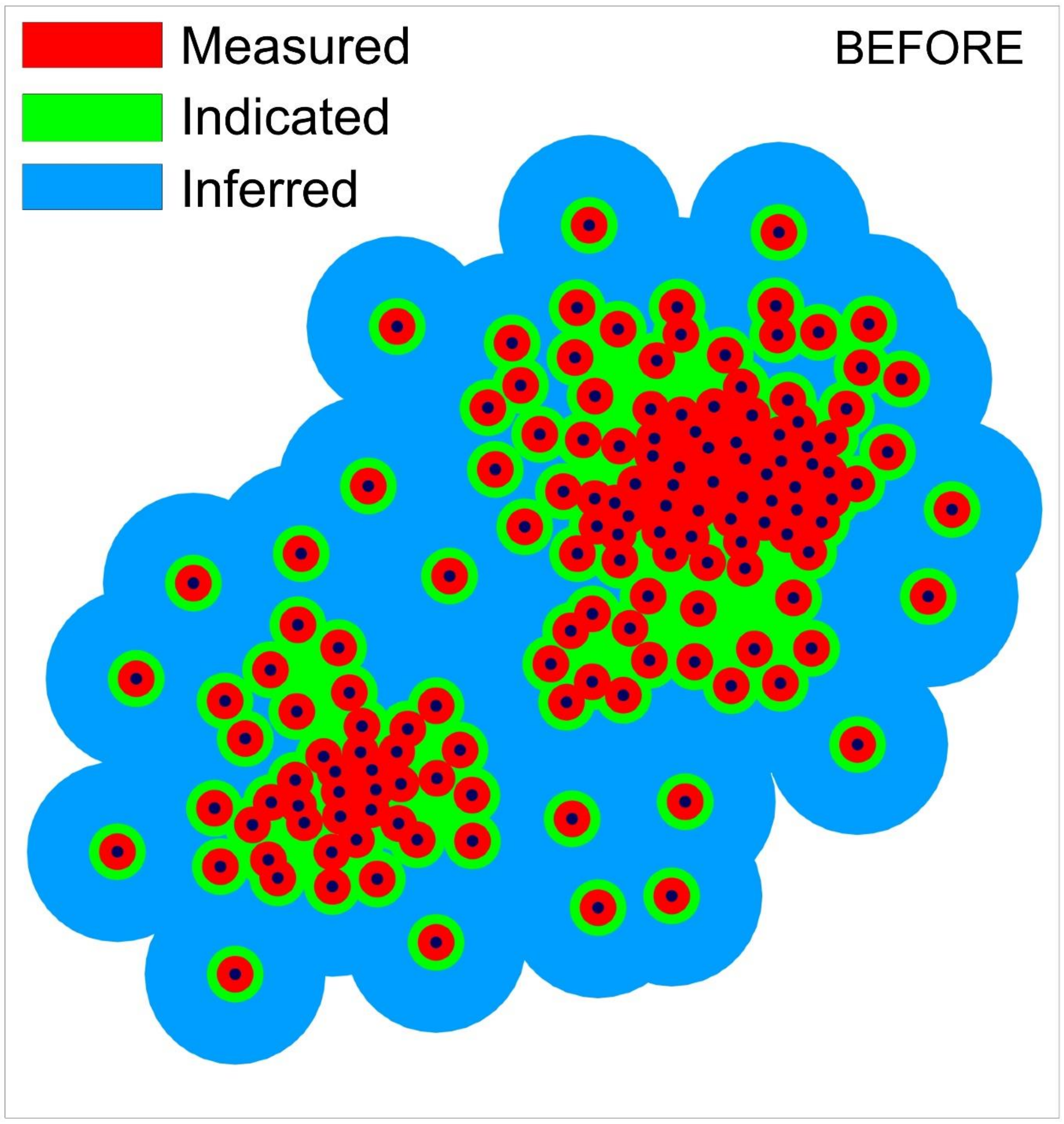
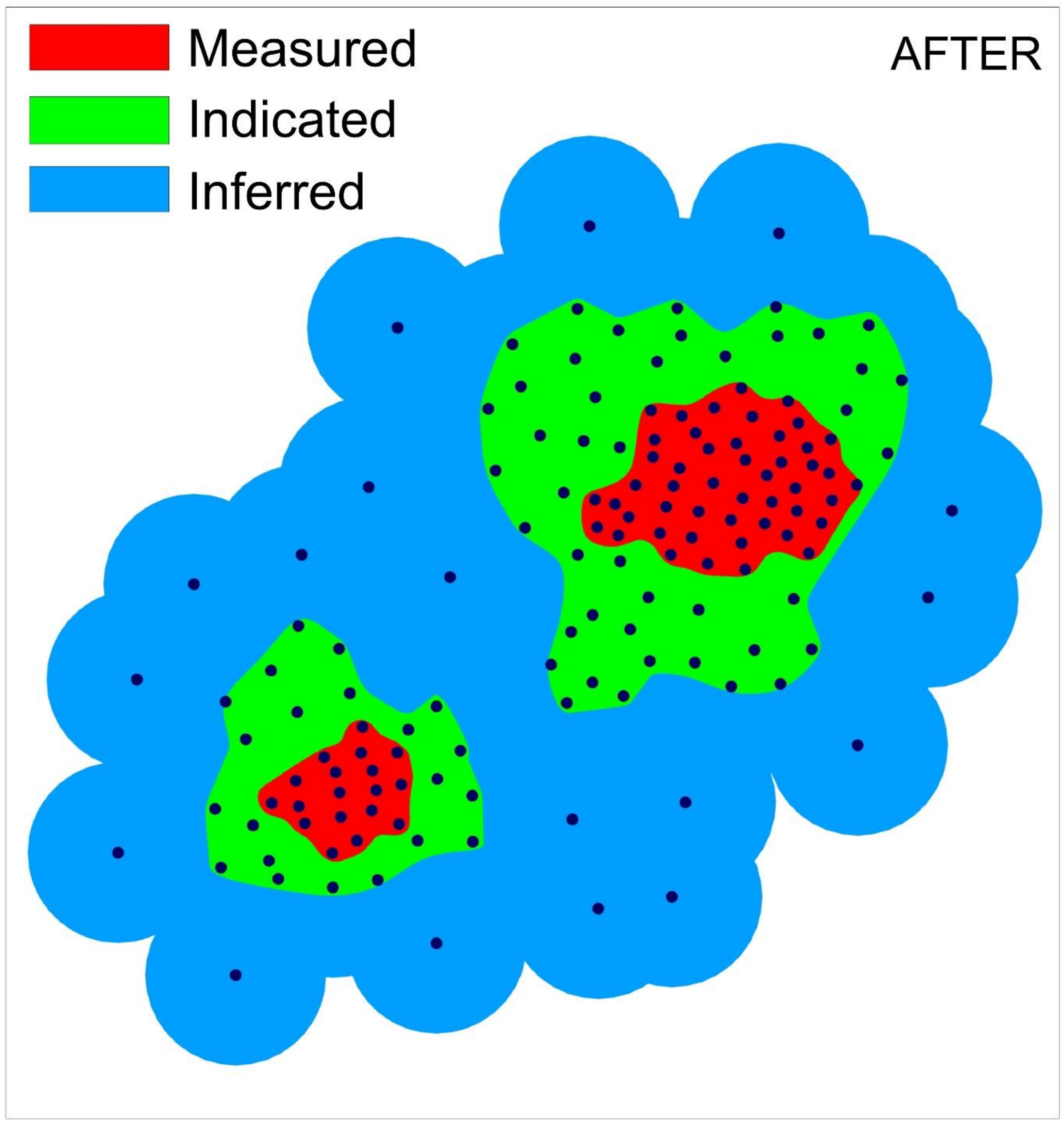
CLASSIFICATION OF MINERAL RESOURCES

(Spotted Dog Effect)

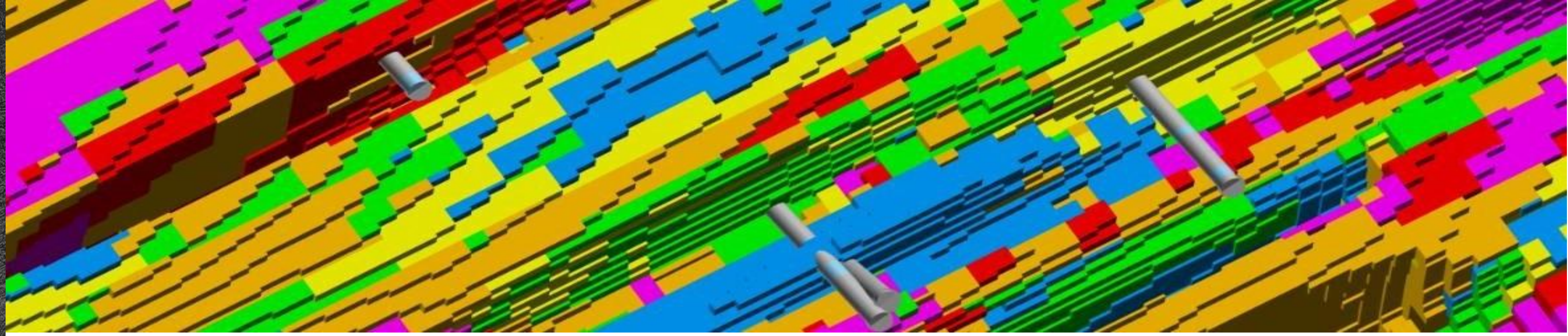


Inspired by the 2006 article and presentations by P.R. Stephenson and colleagues.

MEHMET ALİ
AKBABA,QP,CPG (Geology)



RESOURCE GEOLOGIST



Resource Geologist

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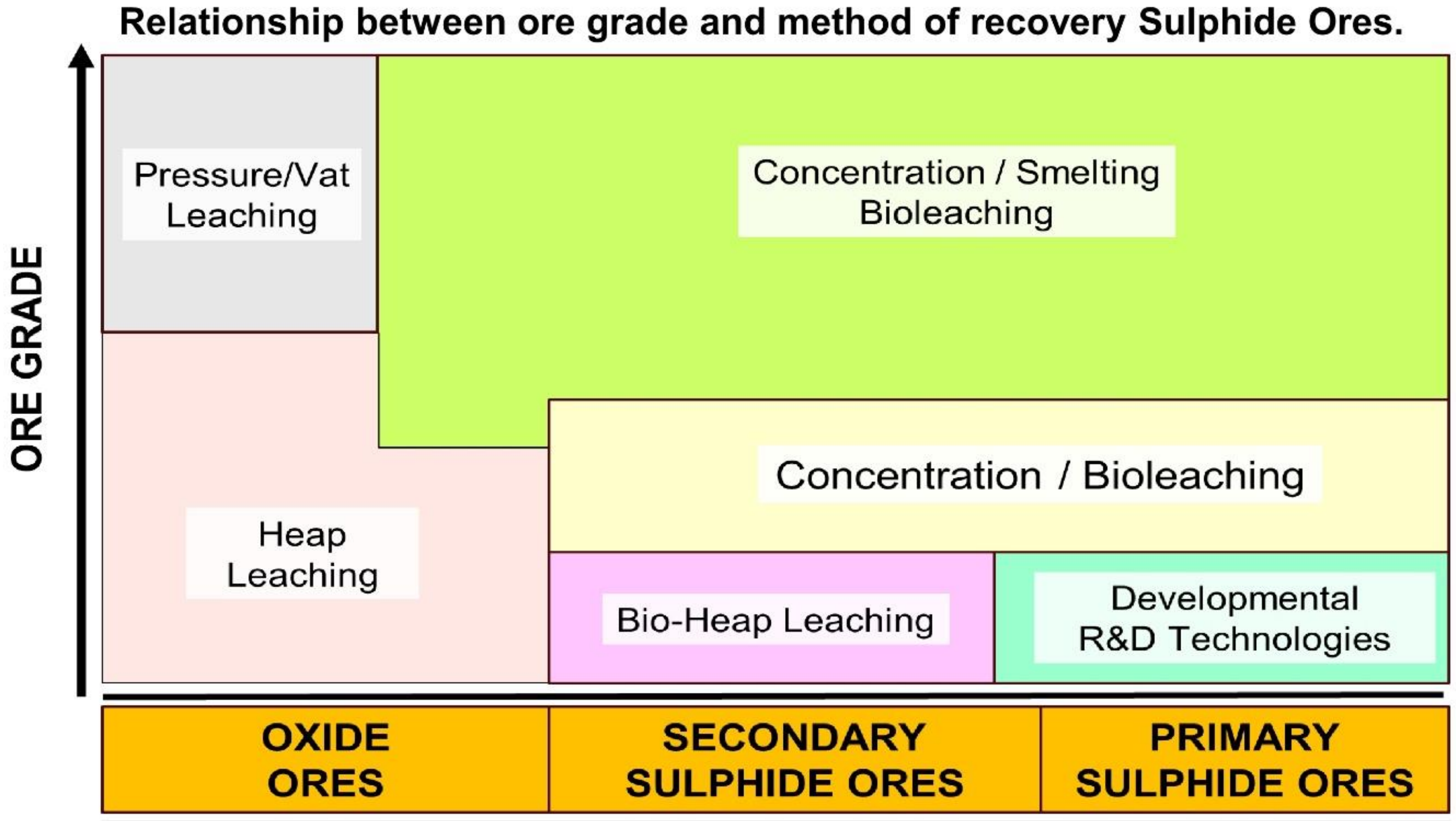
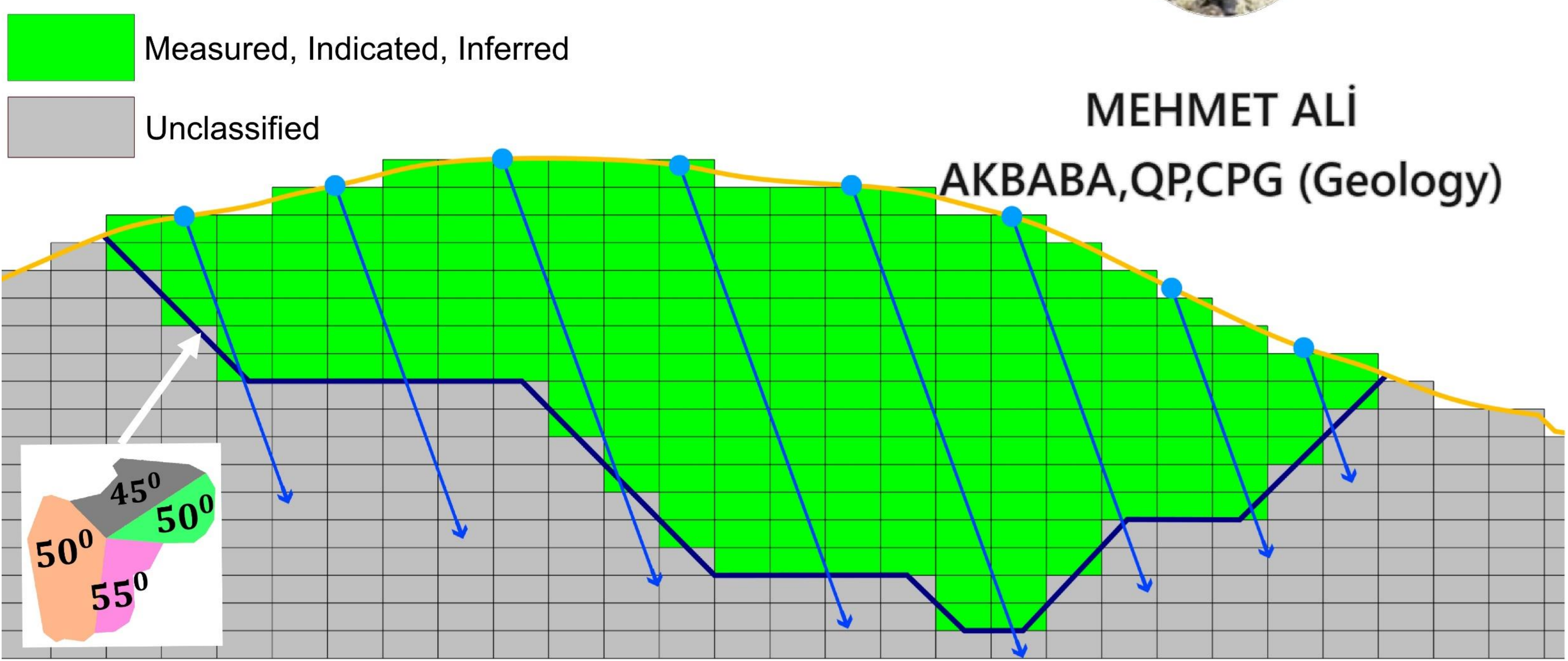
CLASSIFICATION OF MINERAL RESOURCES

(Impact of the Economy)

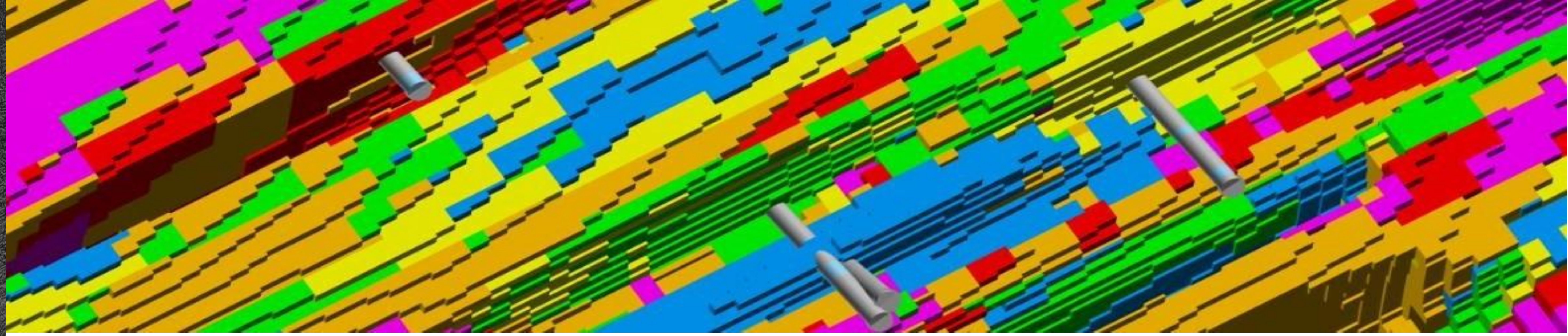


Modified by Zanbak, C. (2012) from Robertson et al., 2005

ECONOMIC PARAMETERS	UNITS
Metal Price	US$/t.oz, US$/lb
Mining Operation Costs Ore - Waste	US$/t, US$/m^3
Mining Dilution Factor	%
Mining Loss Factor	%
Process Cost	US$/t
Metal Recovery	%
Open Pit Slope Angle	^{o}



MEHMET ALİ
AKBABA,QP,CPG (Geology)



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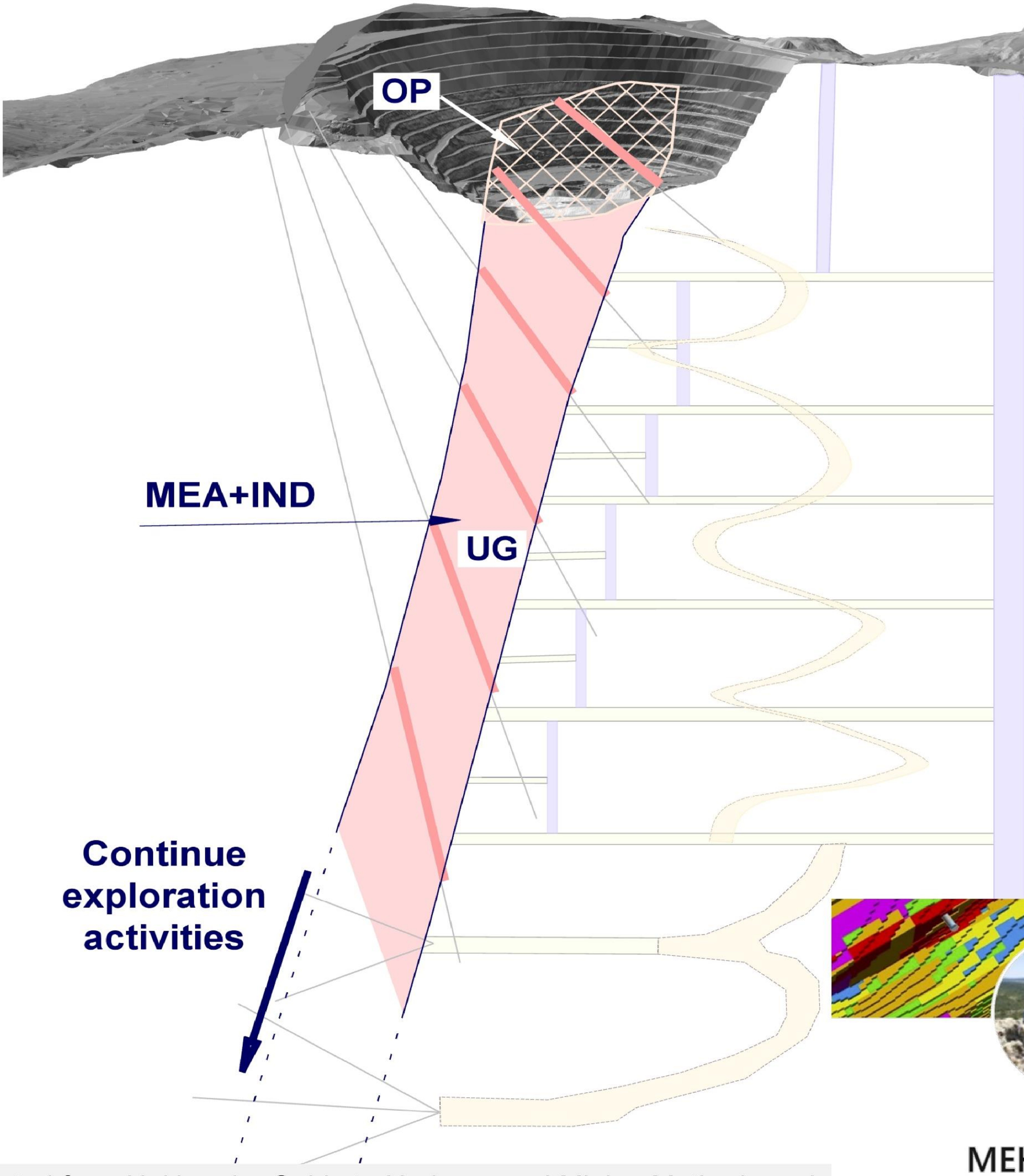
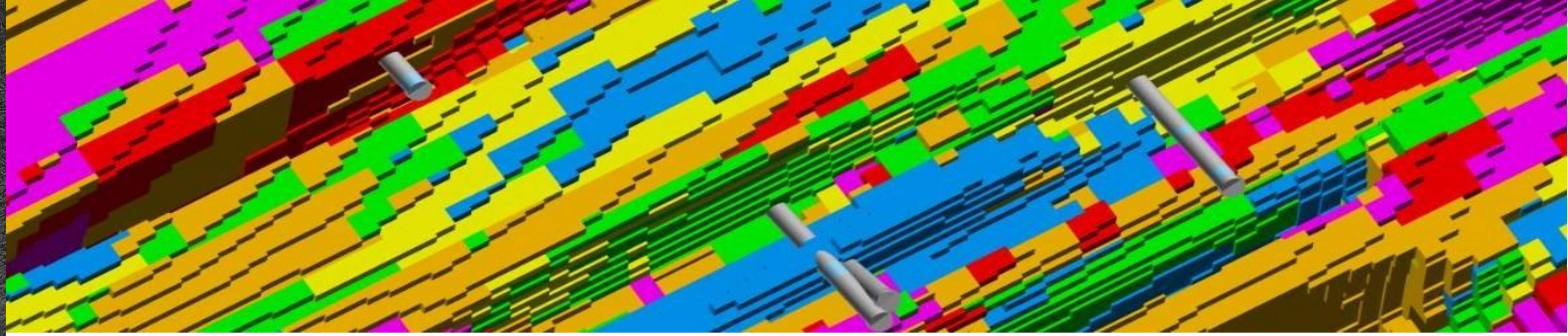
CLASSIFICATION OF MINERAL RESOURCES

(Determining the Mining Method)



Adapted from H. Hamrin, Guide to Underground Mining Methods and Applications, Stockholm: Atlas Copco, 1997

MEHMET ALİ AKBABA,QP,CPG (Geology)



Resource Geologist

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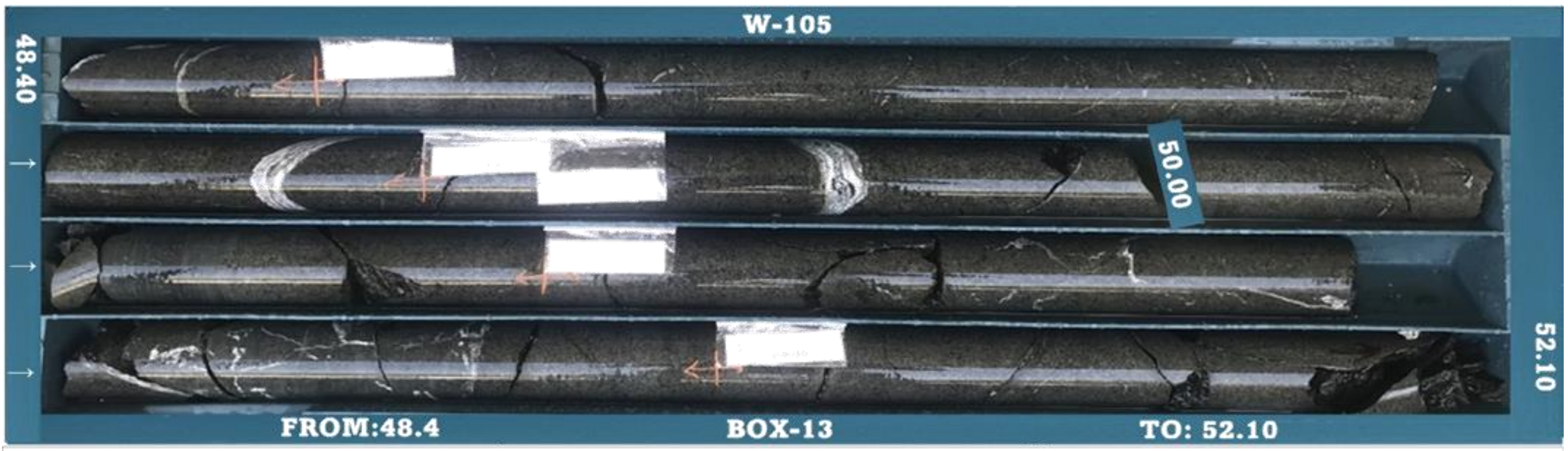
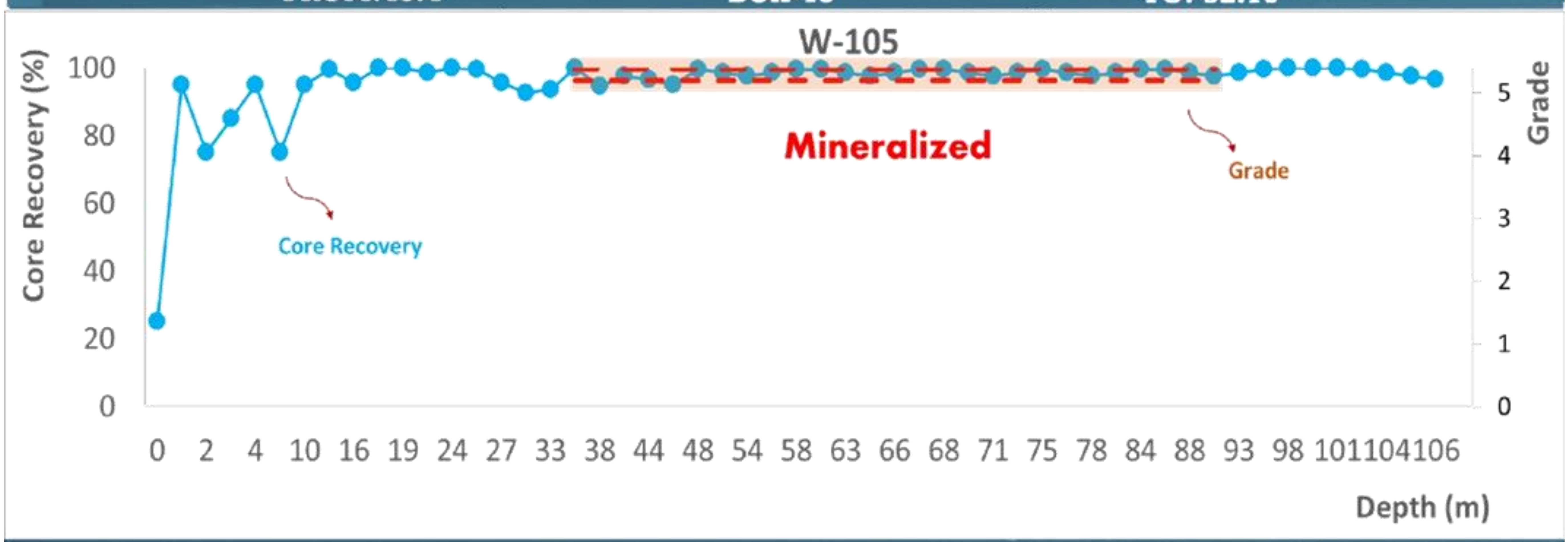
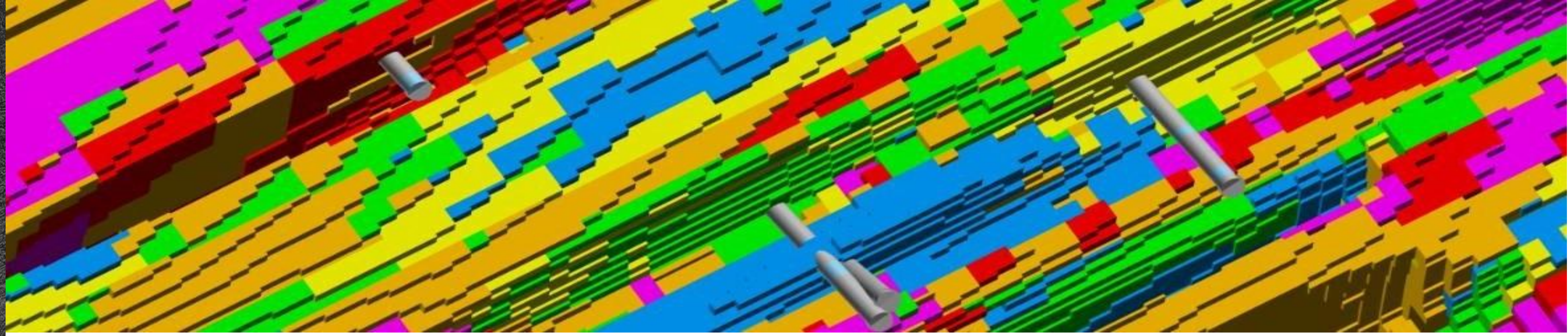
CLASSIFICATION OF MINERAL RESOURCES

(The Role of Core Recovery in Mineral Resource Estimation)

MEHMET ALİ
AKBABA,QP,CPG (Geology)







Resource Geologist

Public Group