AEX METAL MINING
ALANYA MASSIF PROJECT
2021 Q4

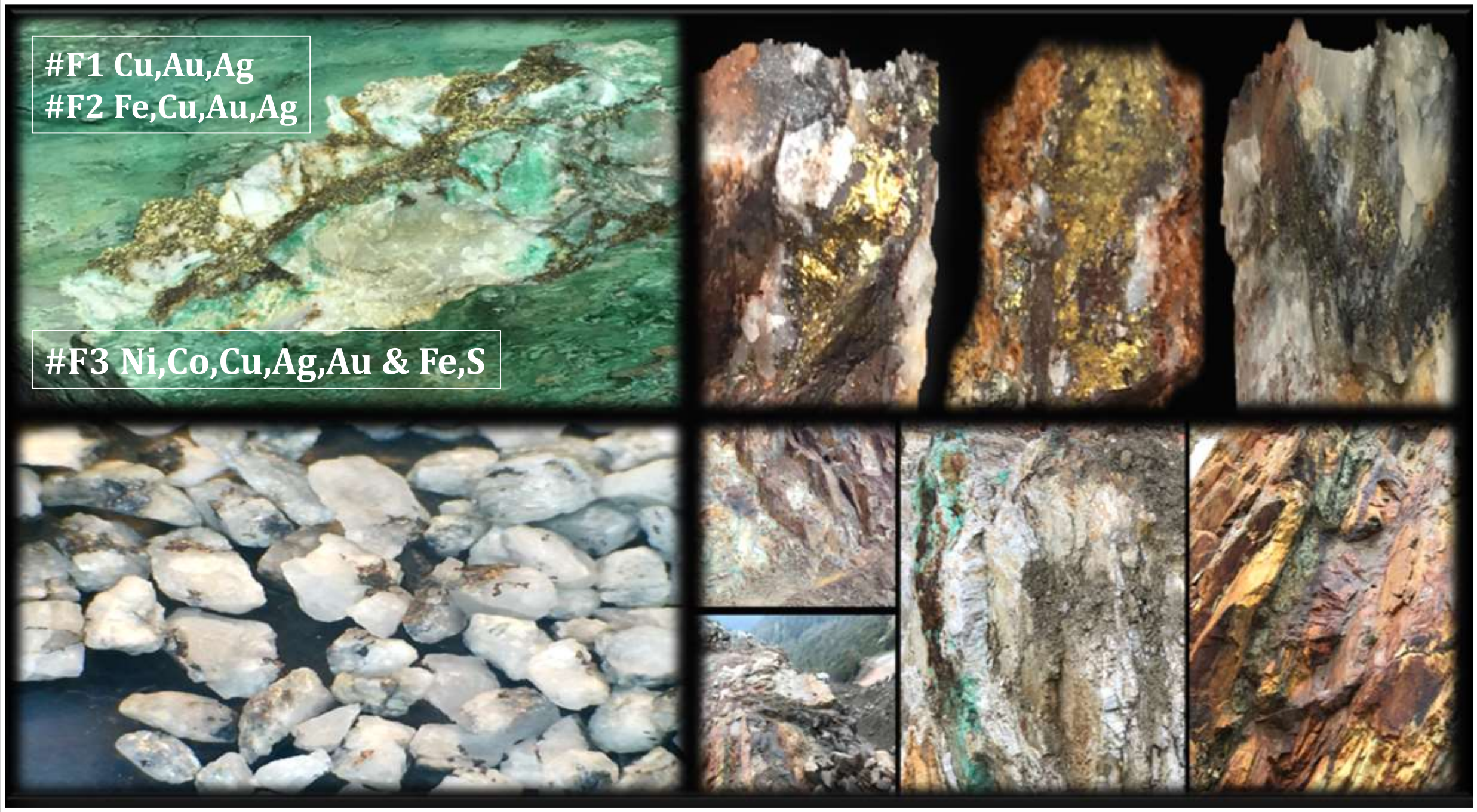
#F3 Magmatic Sulphur Porphyr
Polymetallic Mineralization

" Alanya Massif has the potential of Sudbury & Norilsk Mineral Deposits "

POLYTECTONIC/POLYMETAMORPHIC/POLYMETALLIC
From Precambrian to Cenozoic & From Mantle to Crust

● Battery Metals ● Base Metals ● Minor Metals ● Precious Metals

AEX

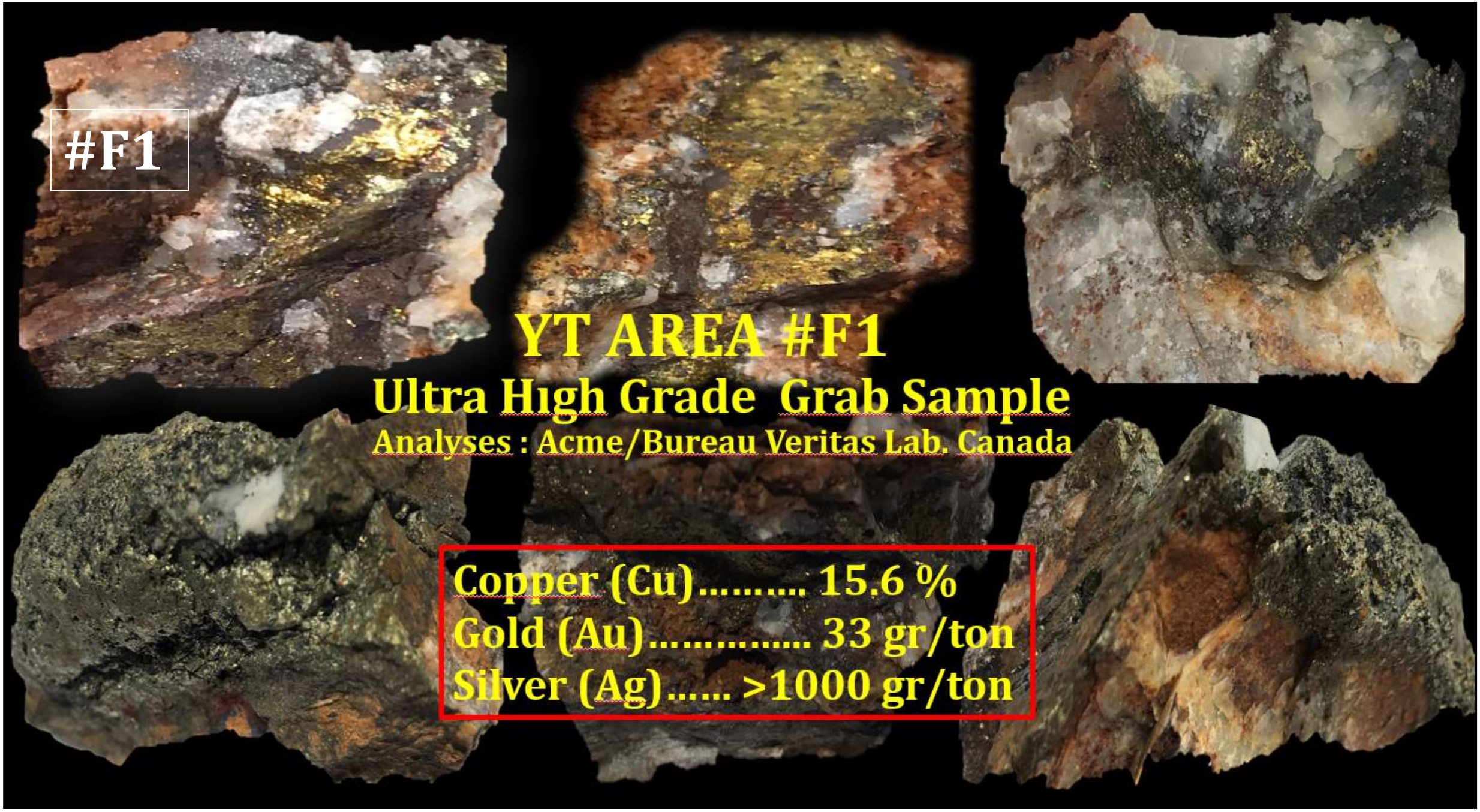

#F1 Cu,Au,Ag
#F2 Fe,Cu,Au,Ag
#F3 Ni,Co,Cu,Ag,Au & Fe,S

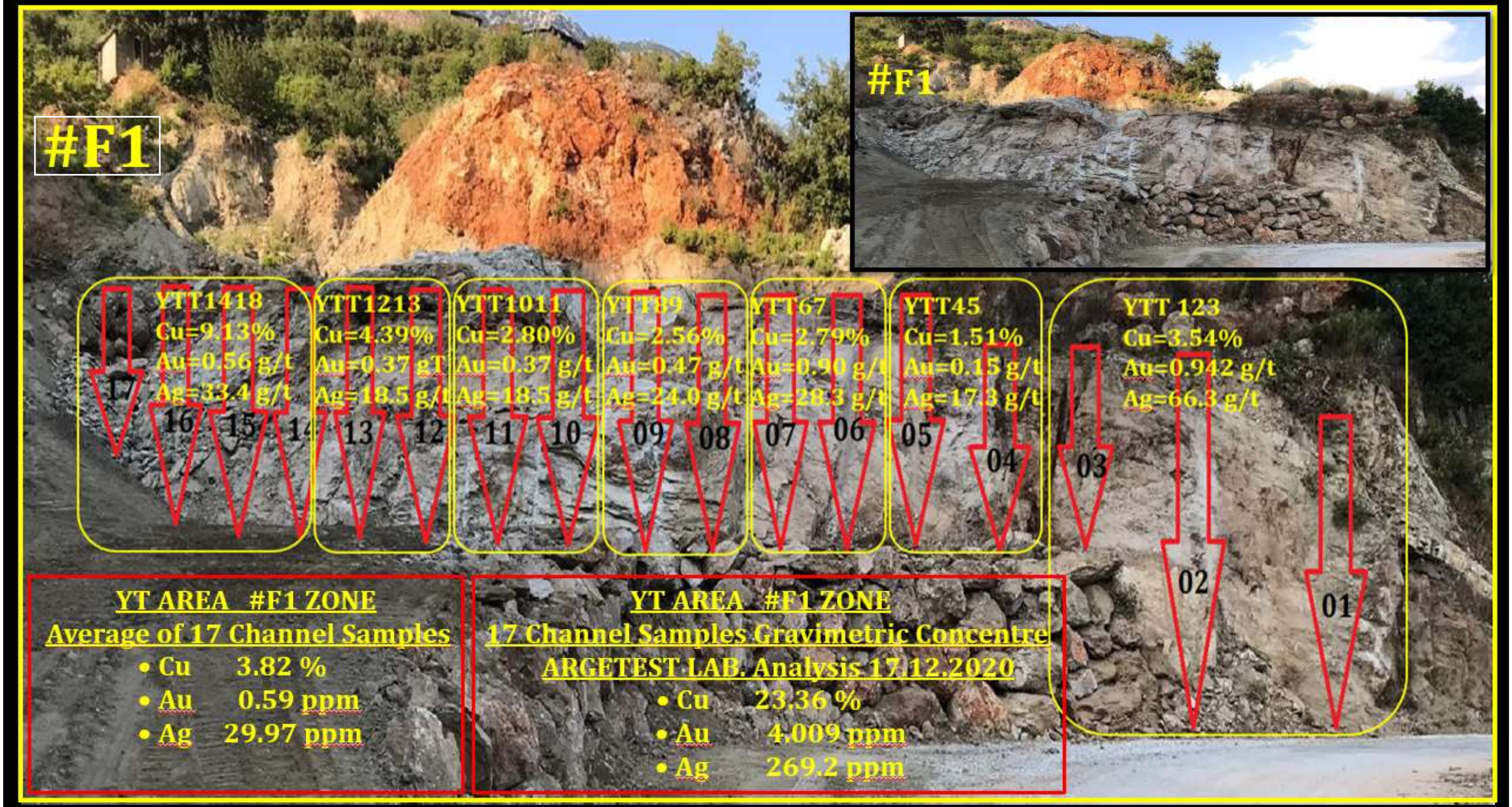
AEX

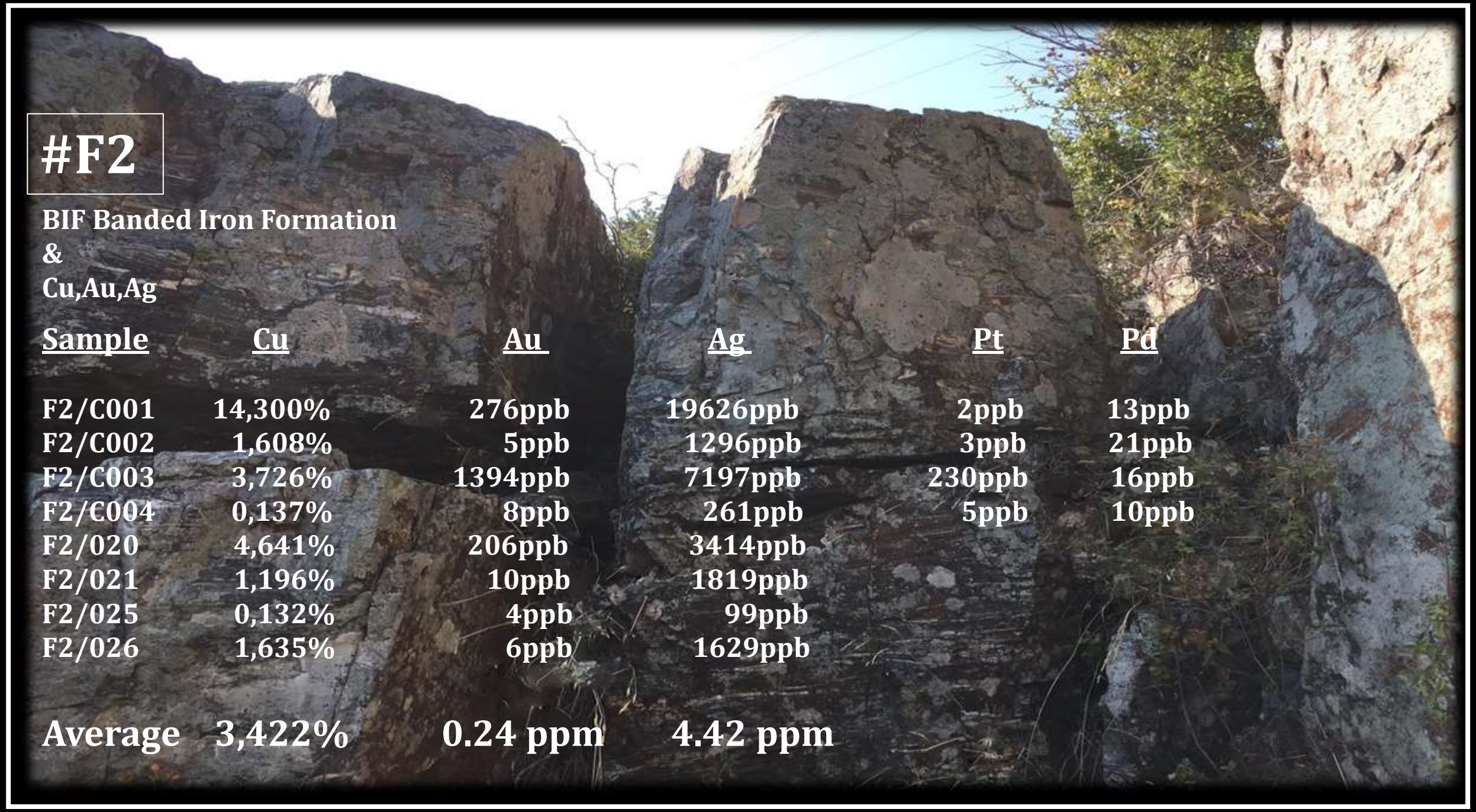
ALANYA MASSİF PROJECT

#F1 Cu,Au,Ag Mineralization
#F2 Fe,Cu,Au,Ag Mineralization
#F3 Polymetallic Mineralization
(Ni,Co,Cu,Pb,Zn,Au,Ag,PGM)


#F1
YT AREA #F1 ZONE
Average of
24 Grab & Chip Samples
• Cu 9.50 %
• Au 2.90 ppm
• Ag 103.80 ppm


#F1
YT AREA #F1
Ultra Hıgh Grade Grab Sample
Analyses : Acme/Bureau Veritas Lab. Canada
Copper (Cu)..... 15.6 %
Gold (Au)..... 33 gr/ton
Silver (Ag)..... >1000 gr/ton


#F1
#F1
YTT1418
Cu=9.13%
Au=0.56 g/t
Ag=33.4 g/t
YTT1213
Cu=4.39%
Au=0.37 gT
Ag=18.5 g/t
YTT1011
Cu=2.80%
Au=0.37 g/t
Ag=18.5 g/t
YTT89
Cu=2.56%
Au=0.47 g/t
Ag=24.0 g/t
YTT67
Cu=2.79%
Au=0.90 g/t
Ag=28.3 g/t
YTT45
Cu=1.51%
Au=0.15 g/t
Ag=17.3 g/t
YTT 123
Cu=3.54%
Au=0.942 g/t
Ag=66.3 g/t
17
16
15
14
13
12
11
10
09
08
07
06
05
04
03
02
01
YT AREA #F1 ZONE
Average of 17 Channel Samples
• Cu 3.82 %
• Au 0.59 ppm
• Ag 29.97 ppm
YT AREA #F1 ZONE
17 Channel Samples Gravimetric Concentre
ARGETEST LAB. Analysis 17.12.2020
• Cu 23.36 %
• Au 4.009 ppm
• Ag 269.2 ppm



#F2

BIF Banded Iron Formation
&
Cu,Au,Ag

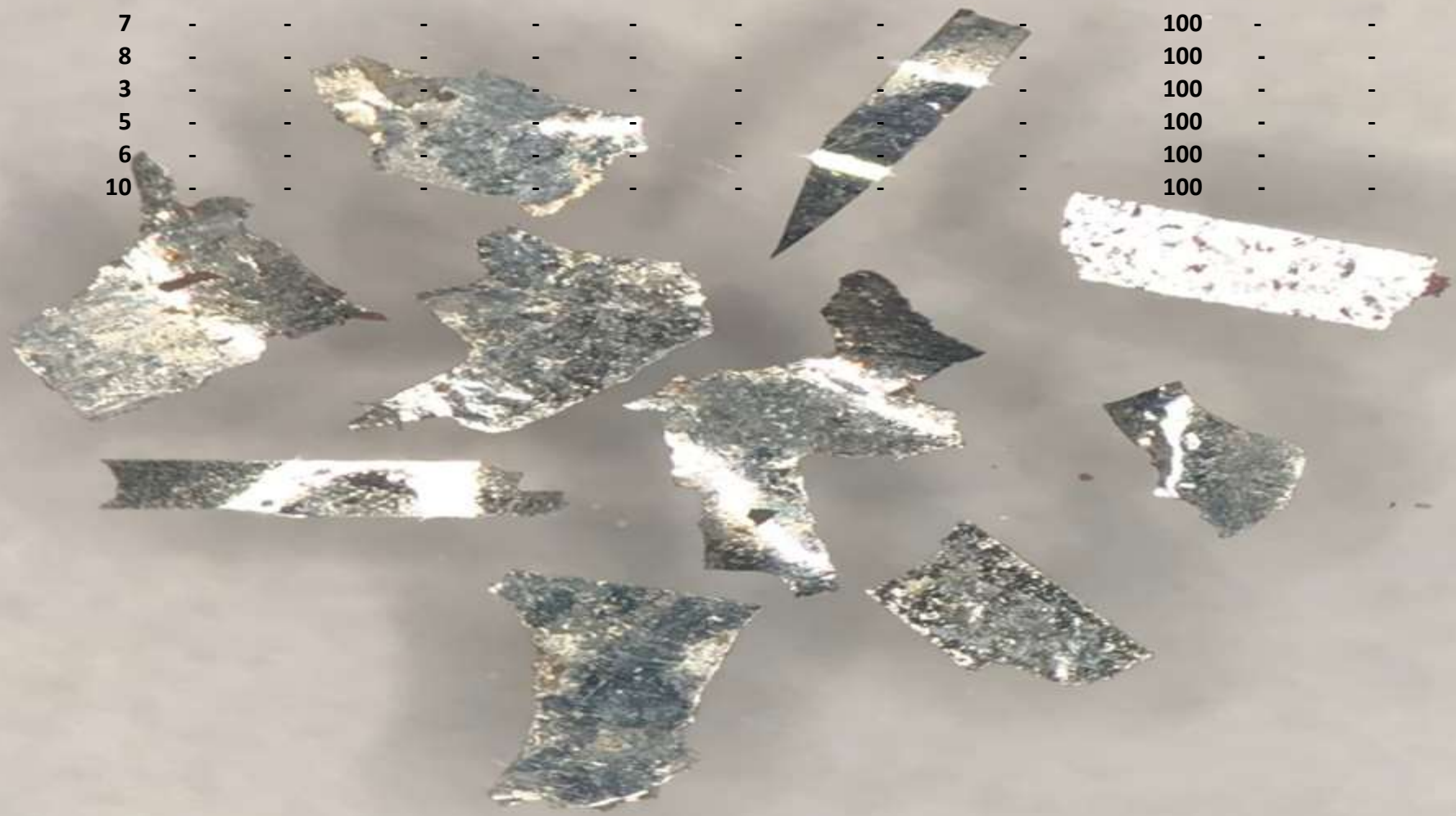
Sample	Cu	Au	Ag	Pt	Pd
F2/C001	14,300%	276ppb	19626ppb	2ppb	13ppb
F2/C002	1,608%	5ppb	1296ppb	3ppb	21ppb
F2/C003	3,726%	1394ppb	7197ppb	230ppb	16ppb
F2/C004	0,137%	8ppb	261ppb	5ppb	10ppb
F2/020	4,641%	206ppb	3414ppb		
F2/021	1,196%	10ppb	1819ppb		
F2/025	0,132%	4ppb	99ppb		
F2/026	1,635%	6ppb	1629ppb		
Average	**3,422%**	**0.24 ppm**	**4.42 ppm**		

#F3

300t Rock Chip , Homogen,Systematic Samples
(Ø 20cm–deep 200mt Rotary Air Blast RAB Drillings)

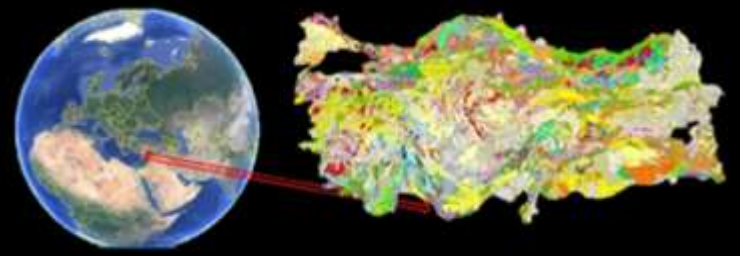
100% Pure Native Metallic Nickel found for the first time in the World

Sample	Grain	Na2O	Al2O3	SiO2	Cl	CaO	TiO2	Cr2O3	FeO	Ni	Cu	Zn	Mo	Pb
SS-J-	7	-	-	-	-	-	-	-	-	100	-	-	-	-
SS-J-	8	-	-	-	-	-	-	-	-	100	-	-	-	-
SS-H-	3	-	-	-	-	-	-	-	-	100	-	-	-	-
SS-H-	5	-	-	-	-	-	-	-	-	100	-	-	-	-
SS-H-	6	-	-	-	-	-	-	-	-	100	-	-	-	-
SS-H-	10	-	-	-	-	-	-	-	-	100	-	-	-	-



Hacettepe University Department of Geological Engineering
EPMA Electron Probe Micro Analysis

AEX ALANYA MASSİF PROJECT
SUMMARY :



● As a result of our uninterrupted exploration activities since June 2016 by applying "CIM Identification Standards", Economic Polymetallic Mineralization was discovered in our 5 license areas covering 8,340 hectares of land in the Alanya Massif.

● This discovery was made in the YT Region, where we have detected the highest anomalies in our significant search areas and where we intensify detailed searches. The first discoveries were made in the #F1 (Cu-Au-Ag) and #F2 (Fe-Cu-Au-Ag-Pd) mineralization zones.

● In the 2020, with the ~ 300 Ton rock chip materials obtained from 15 RAB Drilling opened at a depth of ~ 200mt in an area of 4km X 1km, a numbers of Heavy Mineral Separation (HLS), Magnetic Separation and Chemical analyzes. As a result of these studies, #F3 Porphyry Polymetallic Mineralization (Ni, Co, Cu, Zn, Pb, Au, Ag, Fe, S +PGE) was discovered.

● 10% of the discovered ~ 2 Billion Tons Porphyry Polymetallic Mineralization is Ferro Magnetic and contains Major Pyrrhotite-Pentlandite-Chalcopyrite and other Minerals.

● Strategic Metals Ti-Sc-REE-Li-Rb-Nb-Ta are economically present in the Strong-Weakly Magnetic part with high magnetism which constitutes ~10% of the total mineralization.

- In order to carry out the Technological Tests, ARGETEST Ore Enrichment, R&D and Analysis Ltd. Sti. Continuing the Tests and Analysis, which was initiated within the framework of the contract signed in April 2021 with is being done.

- Due to the unique and rare nature of our ore structure, Argetest with Tests were carried out within the framework of joint coordination, and a large number of Ore preparation and Enrichment tests were carried out primarily to obtain the 1st Concentrate by Magnetic Separation.

- The FM Ferro Magnetic part, which constitutes 10% of the ore, was subjected to experiments with a large number of Gaussian - Magnetism Power made in WLIMS and WHIMS Magnetic Separators and it was determined that the highest efficiency (79%) was obtained with 3250 Gauss WLIMS. (Wet Intensity Magnetic Separator)

- Flotation, Hydrometallurgy and Pyrometallurgy tests, which were initiated with the Ferro Magnetic concentrates obtained, are continuing.

- On the other hand, EDS/SEM analyzes were started at " Hacettepe University Advanced Technologies Application and Research Center " in order to determine the mineralization that controls the whole-rock Base Metals-Precious Metals concentrations and to reveal the general qualitative petrographical-mineralogical properties.

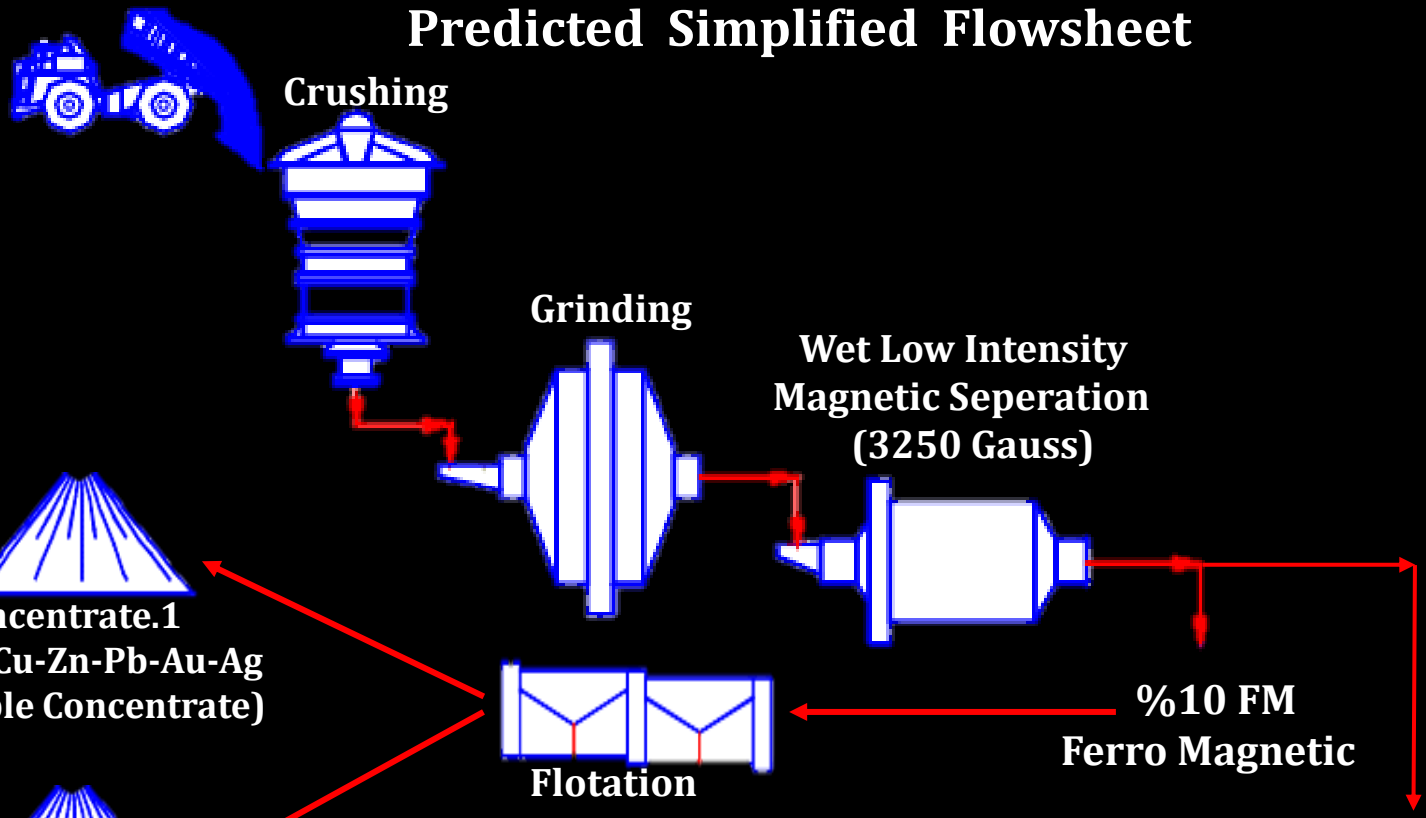
- It is aimed to complete all Technological Tests by the end of 2021.

- In the light of the developments, Strategic Partnership negotiations have been started with the Institutions at the top of the Sector in Turkey and Developed Mining Countries in order to realize the Feasibility, Investment and Production phase within the framework of CIM Standards.

AEX #F3 PROJECT

FM (Ferro Magnetic - %10) & WMH (Weakly Magnetic - %10)

Predicted Simplified Flowsheet



FM = 225 $/Ton
Total Economic Value

AEX
Strategic and Critical Metals
Innovation Company

FM Ferro Magnetic

Main Product

- Nickel
- Cobalt
- Copper
- Zinc
- Lead
- Gold
- Silver

By-product

- Iron
- Sulphur

Conventional
Green Mining

Hıgh Technology
Green Metals

WMH Weakly Magnetic

Main Product

- Titanium
- Scandium
- Iron
- REE

By-product

- Lithium
- Rubidium
- Niobium
- Tantalum

PROJECT UPSIDE POTENTİAL :

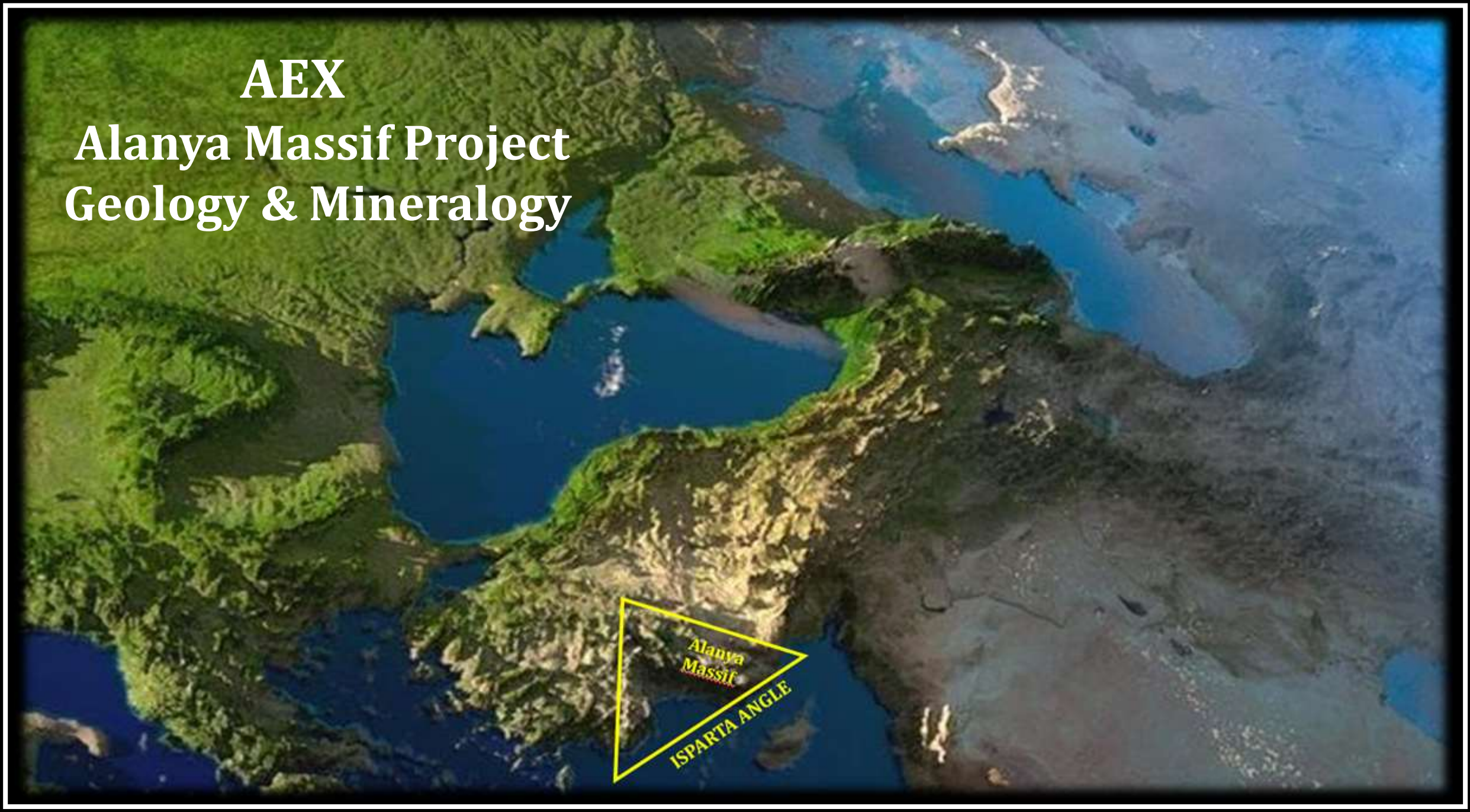
● Preliminary Economic Validity of Magmatic Sulfur Porphyry mineralization discovered in the #F3 Region has been finalized.
In addition to this determination, as a result of the Drilling Program to be made for Resources- Reserves and the Technological Tests & Chemical Analysis to be applied within this framework, the Upper Potentials listed below will be revealed.

● The existence of tectonic and hydrothermal based " High Grade Mineralization " formations has a significant potential.
The presence of these formations has been revealed in all of the important Magmatic Sulphide deposits in the World.
In our project, #F1 Region "Cu, Au, Ag mineralization" and #F2 Region "Fe (Magnetit), Cu, Au, Ag, PGE" Mineralizations in the near-surface parts are important indicators of this potential.

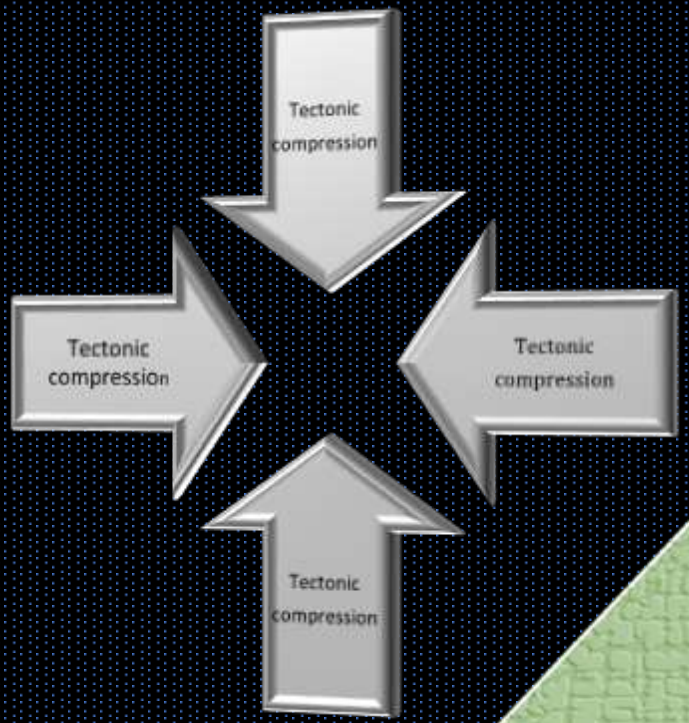
● All current studies represent homogeneous formation up to 200 mt depth and it is predicted that the formation continues deeper.

● Magnetic Separation tests with grain size d50 = 75 µ were completed and 79% efficiency was obtained with WLIMS 3250 Gauss. In tests with d50 = 25 µ, it is seen that the FM Fraction will increase from 10% to 13-15% and the efficiency will increase.

AEX
Alanya Massif Project
Geology & Mineralogy



ALANYA MASSİF
AEX PROJECT
#F3
Simplifield Geology



Cebel-i Reis Mountain 1650mt

GEOLOGICAL FORMATİON	AGE
Marble, Schist in places	Mesozoic

GEOLOGICAL FORMATİON	AGE
Metaclastics and metacarbonates	Upper Cretaceous

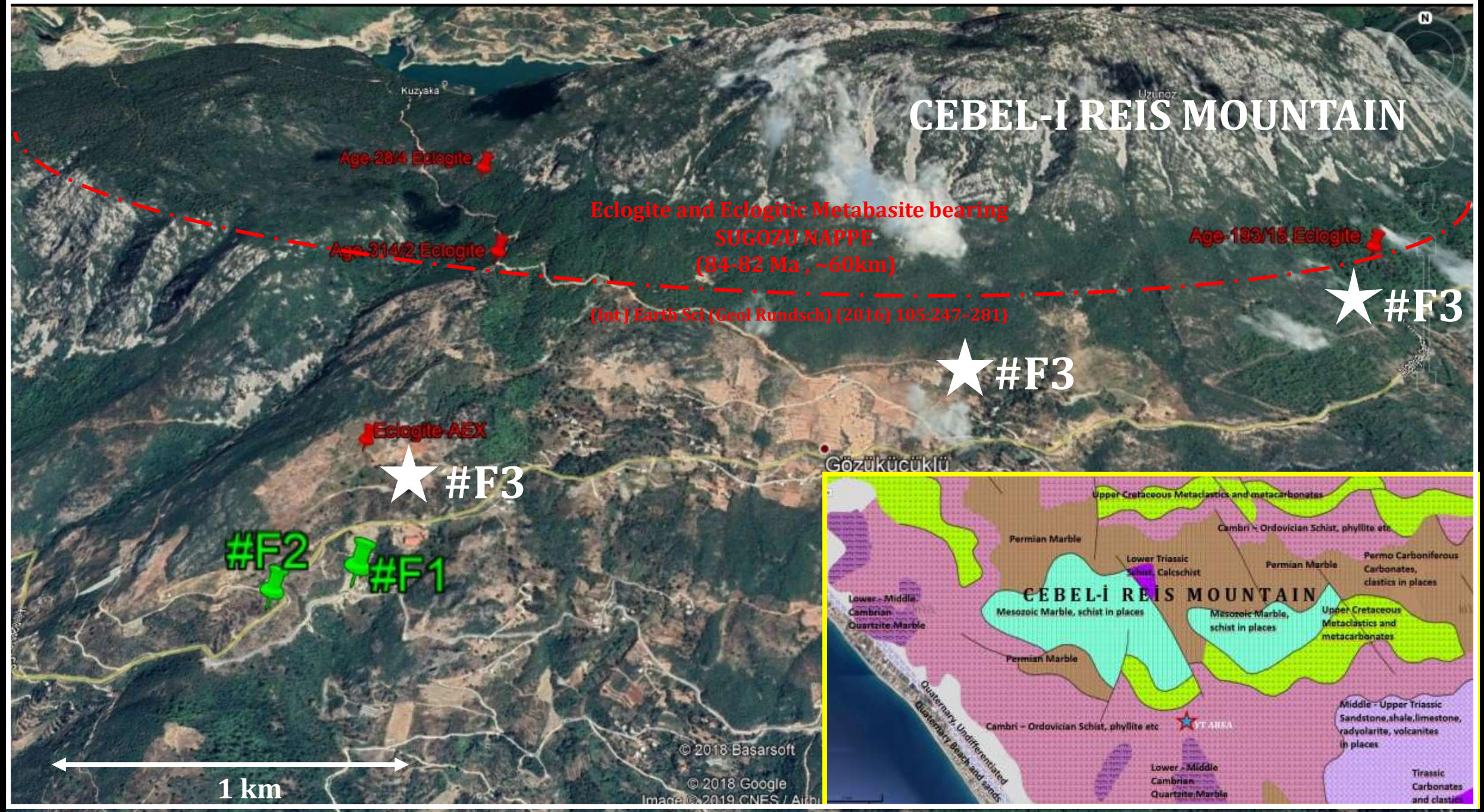
#F3

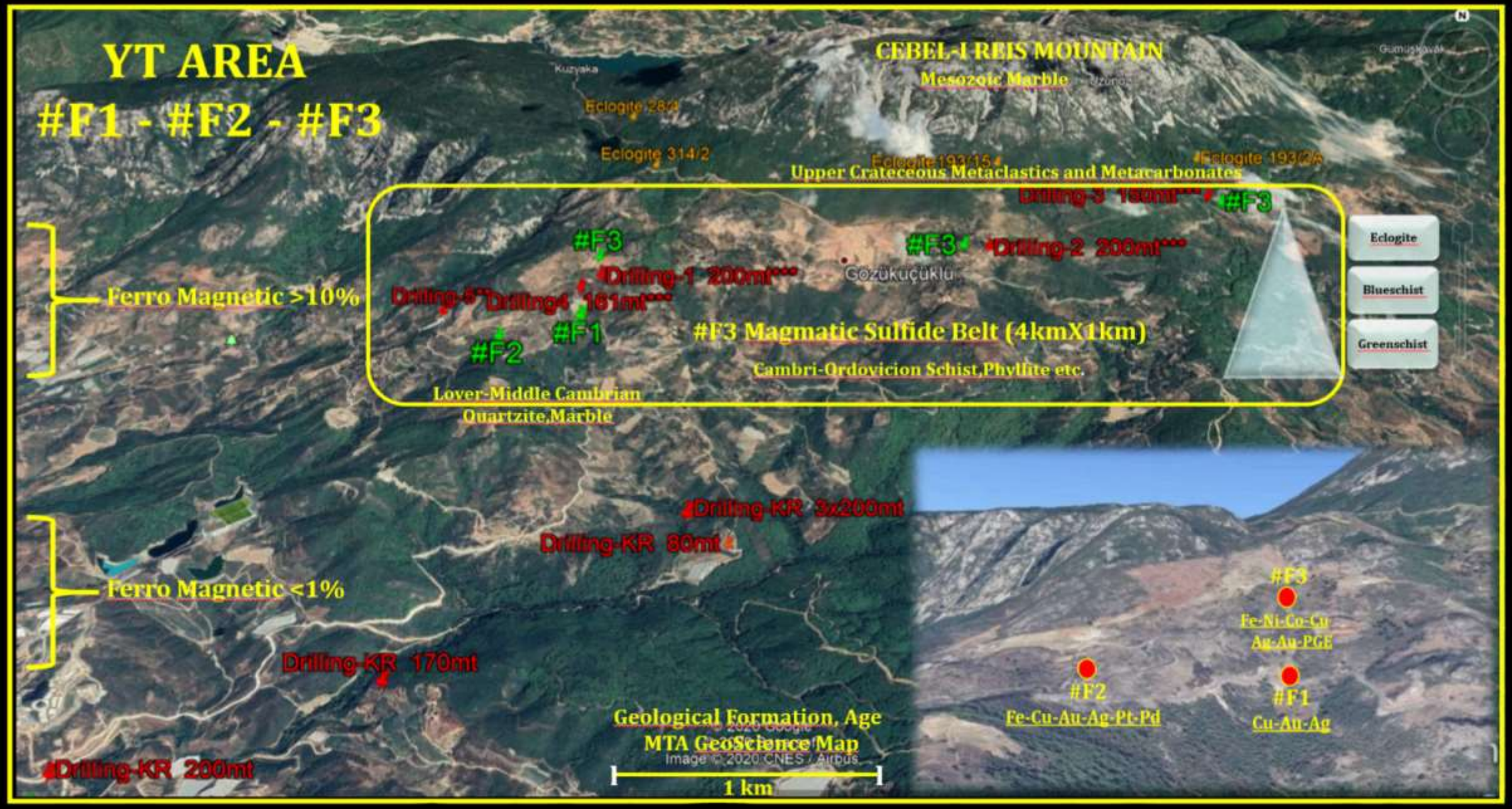
GEOLOGICAL FORMATION	AGE
Schist, phyllite etc.	Cambri - Ordovician

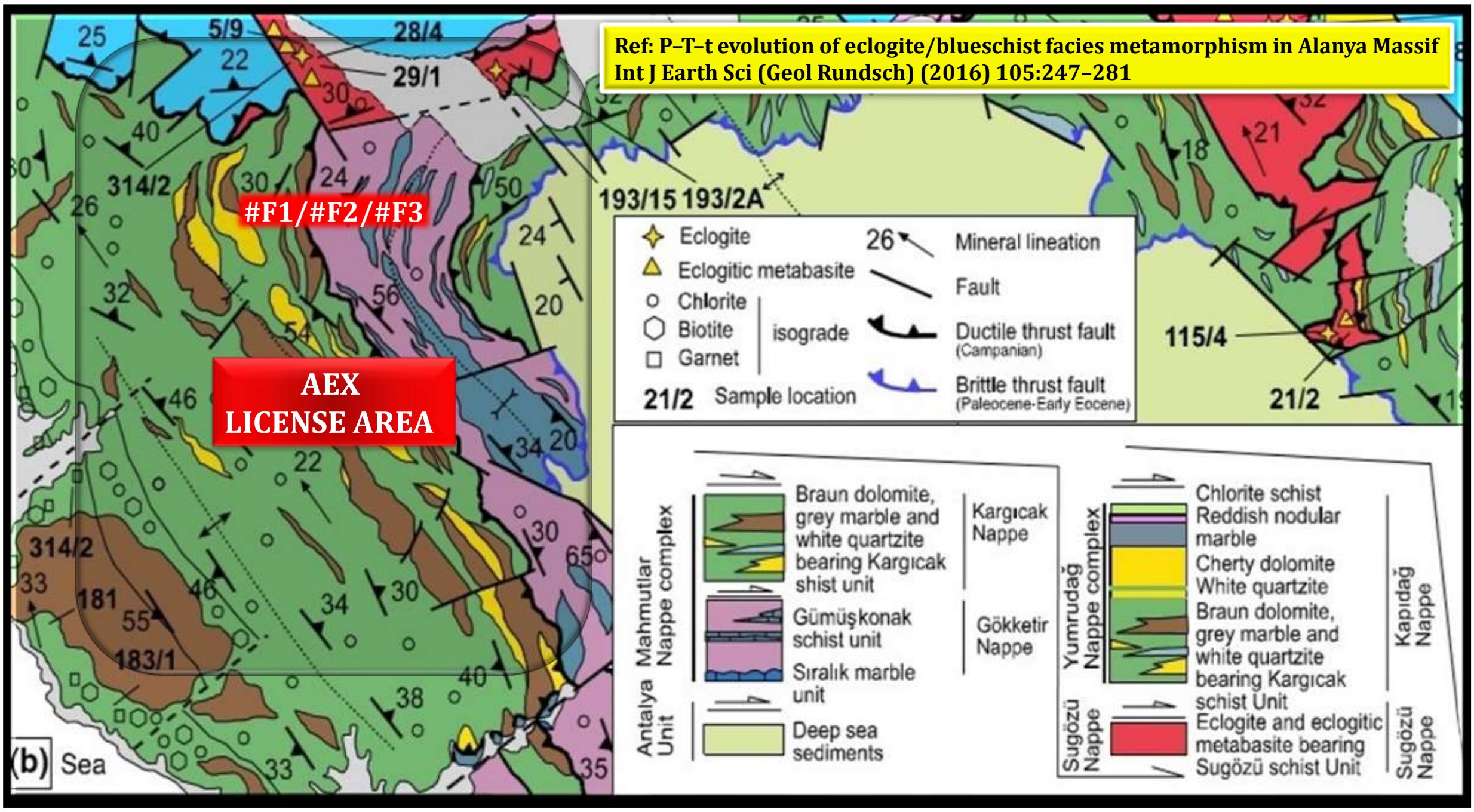
Eclogite

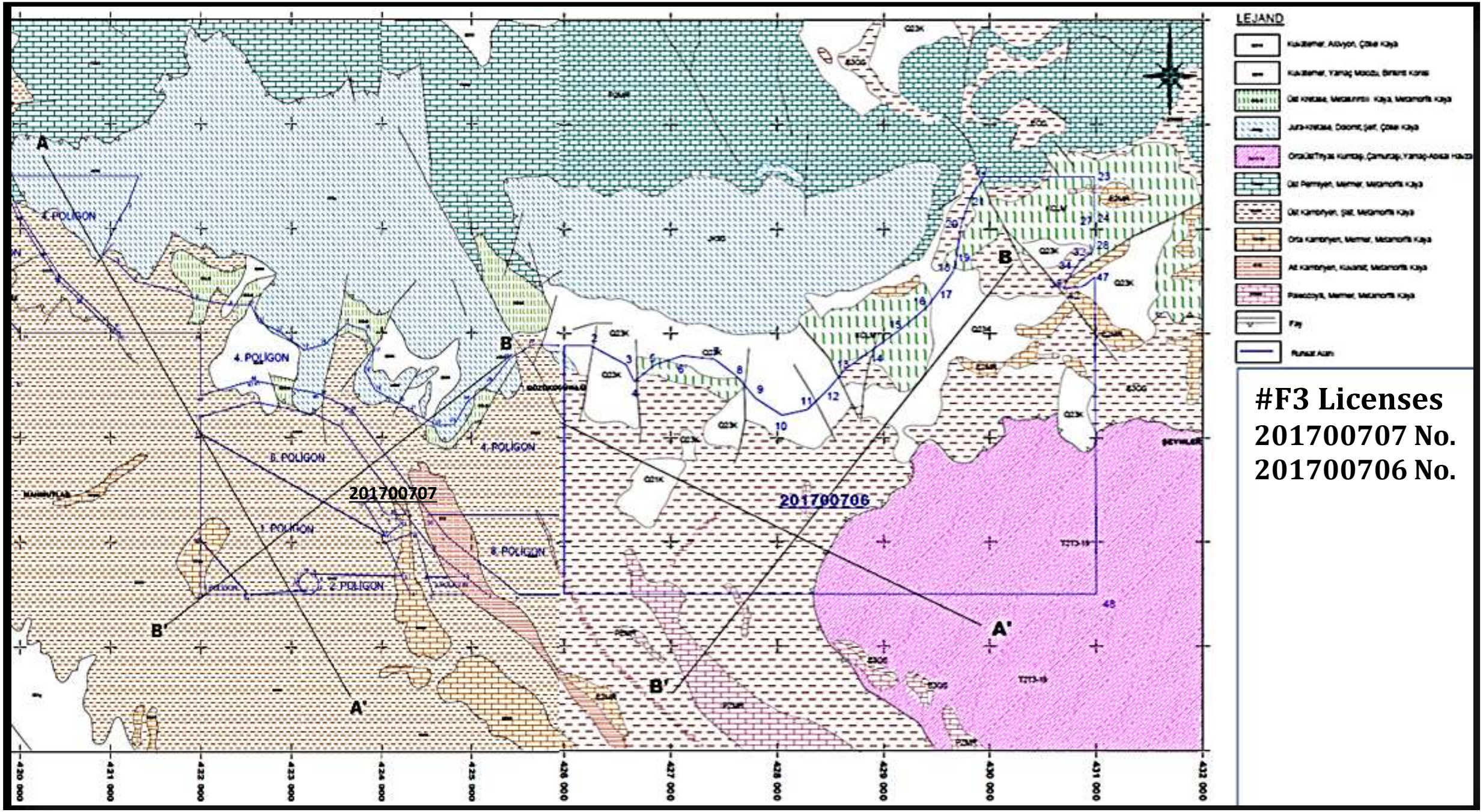
BlueSchist

GreenSchist


CEBEL-I REIS MOUNTAIN
Kuzyaka
Uzunöz
Age-284 Eclogite
Age-314/2 Eclogite
Age-193/15 Eclogite
Eclogite and Eclogitic Metabasite bearing
SUGOZU NAPPE
(84-82 Ma , ~60km)
(Int J Earth Sci (Geol Rundsch) (2016) 105:247–281)
#F3
#F3
#F3
Eclogite-AEX
Gözükücüklü
#F2
#F1
1 km
© 2018 Basarsoft
© 2018 Google
Image © 2019 CNES / Airbu
Upper Cretaceous Metaclastics and metacarbonates
Permian Marble
Cambri – Ordovician Schist, phyllite etc
Lower Triassic
Schist, Calcschist
Permian Marble
Permo Carboniferous
Carbonates,
clastics in places
CEBEL-İ REİS MOUNTAIN
Lower - Middle
Cambrian
Quartzite Marble
Mesozoic Marble, schist in places
Mesozoic Marble,
schist in places
Upper Cretaceous
Metaclastics and
metacarbonates
Permian Marble
Quaternary Undifferentiated
Quaternary Beach and sands
Cambri – Ordovician Schist, phyllite etc
YT AREA
Middle - Upper Triassic
Sandstone,shale,limestone,
radyolarite, volcanites
in places
Lower - Middle
Cambrian
Quartzite Marble
Tirassic
Carbonates
and clastics


YT AREA
#F1 - #F2 - #F3
CEBEL-I REIS MOUNTAIN
Mesozoic Marble
Kuzyaka
Eclogite 284
Eclogite 314/2
Eclogite 193/15
Upper Crateceous Metaclastics and Metacarbonates
Drilling-3 150mt***
#F3
#F3
#F3
Drilling-2 200mt***
Drilling-1 200mt***
Gözükuçüklü
Drilling-5
Drilling-4 161mt***
#F1
#F2
#F3 Magmatic Sulfide Belt (4kmX1km)
Cambri-Ordovicion Schist,Phyllite etc.
Lover-Middle Cambrian
Quartzite,Marble
Eclogite
Blueschist
Greenschist
Ferro Magnetic >10%
Ferro Magnetic <1%
Drilling-KR 3x200mt
Drilling-KR 80mt
Drilling-KR 170mt
Drilling-KR 200mt
Geological Formation, Age
MTA GeoScience Map
1 km
#F3
Fe-Ni-Co-Cu
Ag-Au-PGE
#F2
Fe-Cu-Au-Ag-Pt-Pd
#F1
Cu-Au-Ag


Ref: P–T–t evolution of eclogite/blueschist facies metamorphism in Alanya Massif
Int J Earth Sci (Geol Rundsch) (2016) 105:247–281
#F1/#F2/#F3
AEX
LICENSE AREA
193/15
193/2A
115/4
21/2
Eclogite
Eclogitic metabasite
Chlorite
Biotite
Garnet
isograde
Sample location
Mineral lineation
Fault
Ductile thrust fault
(Campanian)
Brittle thrust fault
(Paleocene-Early Eocene)
Antalya Unit
Mahmutlar Nappe complex
Braun dolomite, grey marble and white quartzite bearing Kargıcak shist unit
Gümüşkonak schist unit
Sıralık marble unit
Deep sea sediments
Kargıcak Nappe
Gökketir Nappe
Yumrudağ Nappe complex
Chlorite schist
Reddish nodular marble
Cherty dolomite
White quartzite
Braun dolomite, grey marble and white quartzite bearing Kargıcak schist Unit
Eclogite and eclogitic metabasite bearing Sugözü schist Unit
Sugözü Nappe
Kapıdağ Nappe
(b) Sea


LEJAND
#F3 Licenses
201700707 No.
201700706 No.
201700707
201700706
A
A'
B
B'
4. POLİGON
3. POLİGON
2. POLİGON
8. POLİGON

AEX PROJECT Geology/Mineralogy

(Alanya Massif / Sugözü Nappe / Cebel-i Reis Mountain / # F3 Magmatic Sulphide Porphyry Mineralization)

● "ALANYA MASSIF" consists of a Precambrian basement, which is thought to correspond to the Pan-African Basement of the Gondwana Plate, and a Paleozoic-Mesozoic metasedimentary cover.

It contains Precambrian basement in its core and generally covers Paleozoic units; A south-overturned anticlinorium and a Southeast-dipping synclinorium consisting mostly of Mesozoic aged units and a north-dipping tectonic slicing form the structure of the Alanya Massif.

As a result of the academic studies carried out until today and the mining activities carried out by us in Isparta-Burdur-Alanya region in the last 15 years, it has been determined that the "Isparta Angle" is African origin, Precambrian Old Craton. "Alanya Massif" is located on the Southeast wing of Isparta Angle.

● "SUGÖZÜ NAPPE" It has been proven by scientific studies that Sugözü Nappe is 84-82 Ma old and originates from ~ 60 km, and it consists of High Pressure - Low Temperature (HP / LT) metamorphic rocks.

Sugözü Nappe, which also contains Eclogite, Eclogitic Metabasite and Blue Schists, is composed of Precambrian aged Metamorphic schists. Eclogites and Bedrock first transformed into Blue Schist facies and eventually Green Schist facies. The mineral assemblage of Schists on the surface consists of garnet, glaucophane, phengite, sphene, calcite, quartz, albite and opaque oxides, and at the base there are Chlorite, Mica, Quartz, Albite and Magmatic Sulfide Minerals.

● "CEBEL-I REIS MOUNTAIN" The main mass of Cebel-i Reis Mountaın consists of Paleozoic-Mesozoic aged hard and thick bedded gray-dark gray limestone formation with little metamorphic crystallization and Marble and Dolomite formations. Cebel-Reis Mountain with an altitude of 1650 meters is the only mountain in the region that is formed perpendicular to the sea. Orogenic structure is with Lithospheric Riftization developed in Tectonic processes; or it may be in the structure of Extrusive-Volcanic mountains, which are generally composed of single mountains, formed by the rise of the magma in the depths of the earth from the weak and cracked parts of the earth's crust.

● " #F3 MAGMATIC SULPHIDE PORPHYRY ORE "
As a result of the Petrographic, Mineralogical and Chemical Analyzes of the samples obtained from the RAB chip drillings made from 15 different points of the southern slope of Cebel-i Reis Mountain;
It continues in the East-West direction with an extension of > 4 km and a depth> 200m; Economic Magmatic Sulfur Polymetallic Mineralization, which contains Pyrrhotine, Pentlandite and Chalcopyrite, which are the main Sulfur phases found in mantle rocks, begins after 15-20 m depth from the surface.

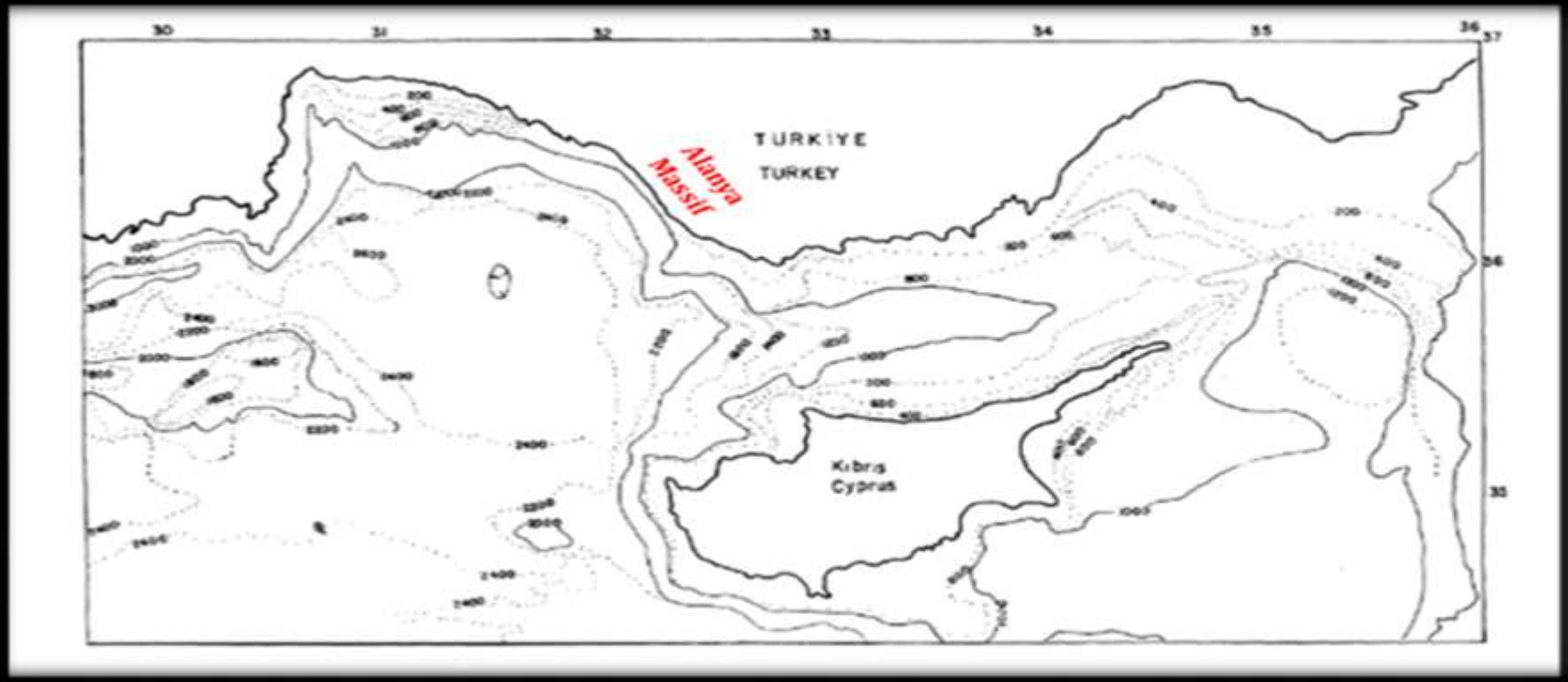
F3 Magmatic Sulphide Mineralization consists of billions of tons of economic resources and the Ferro Magnetic Fraction which constitutes ~ 10% of Polymetallic Mineralization includes the following Metals; Ni 1870 g/t - Co 425 g/t - Cu 834 g/t – Zn 462 g/t - Pb 420 g/t - Ag 8 g/t - Fe 45% - S 30%

● In certain parts of the # F3 Magmatic Sulphide Belt, High Grade Mineralization occurrences of Tectonic - Hydrothermal origin and formed by the Natural Concentration of the Metals at the Base have occurred;
F1 Mineralization contains 3.8% Cu, 0.60 g/t Au, 30g/t Ag
F2 Mineralization contains 3.4% Cu, 0.24 g/t Au, 4.4g/t Ag and > 40% Fe.

Alanya Massif & Seismic Data

The North-Eastern Mediterranean Sea, in the light of marine seismic reflection data
Güven Özhan MTA Genel Müdürlüğü Jeofizik Etüdleri Dairesi, Ankara.

● Profilin en kuzey kısmında, Plio- Kuaterner deniz tabanına doğru yükselim gösteren <u>temel kaya niteliğindeki formasyon Alanya Masifinin denizdeki uzantısı üzerine incelerek yaslanmaktadır.</u>
Alanya Masifine ait reflektörlerin ani olarak Tersiyer ve daha yaşlı formasyonlara ait reflektörler altına daldığı izlenebilmektedir. Batimetrik veriler incelendiğinde Alanya Masifinin denizdeki uzantısı ve bu uzantının güneyde Kıbrıs ile birleştiği kanısı uyanmaktadır.



Şekil 11. Profil L.
AM: Alanya Masifi PQ: Pliyo-Kuvaterner, E: Evaporit T: Tersiyer SF: Deniz tabanı SD: Tuz domu M: Mesozoyik D: Dom
Figure 11. Line L.
AM: Alanya Massive PQ: Plio-Quaternary E: Evaporite T: Tertiary SF: Sea floor SD: Salt dome M: Mesozoic D: Dome

"Isparta Angle" & "Alanya Massif" is African origin Precambrian age Old Craton.

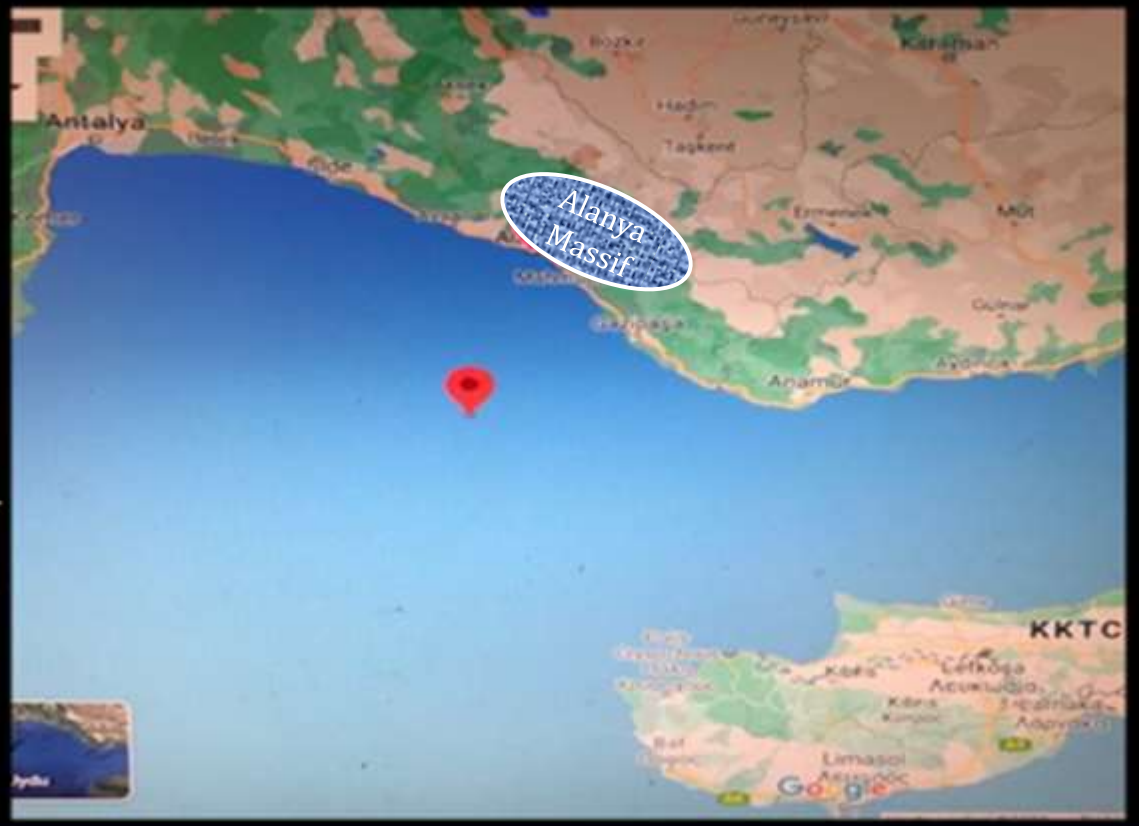
Alanya Massif & Earthquake

KANDİLLİ RASATHANESİ VE DEPREM ARAŞTIRMA ENSTİTÜSÜ (KRDAE)

Tarih	Saat	Enlem(N)	Boylam(E)	Derinlik(km)	ML	Yer
2020.12.05	15:44:39	35.9985	31.8108	93.3	5.4	AKDENIZ

Prof. Dr. Şükrü Ersoy
Derinlik çok enteresan. 80 kilometrelik derinlik, ancak dalma batmayı karakterize eder. Aynı Rodos ve Girit'in altına dalan Afrika kıtasının oluşturduğu deprem gibi. Bunun Antalya açıklarında olmaması gerekir.

Prof. Dr. Naci Görür
"Antalya'da olan deprem Kıbrıs-Helen yayı ile ilgili olmalıdır. Deprem dalma-batma zonunun Anadolu levhası üzerinde ve görece kıyıya yakın bir yerde olduğu için şiddetli hissedilmiş olabilir"



Prof. Dr. Ahmet Ercan
" Antalya'da bu büyüklükte bir deprem son yıllarda hiç görülmedi. Bu akıllara zarar. "

" Bu kaktırmanın ana nedeni Afrika ana karası. Afrika ana karası, tıpkı Güney Ege Dalma-Batma Kuşağı gibi hem Kıbrıs'ı hem de Anadolu'yu kuzeye doğru sürülüyor. "

" Türkiye anakarasında bu derinlikte depremler olmaz. Bu nedenle şu andaki bu deprem aslında Afrika ana karası üzerinde oluyor. Afrika ana karasının üzerinden bir parça kopuyor. 69 kilometre derinde bir parça koptuğu zaman bir sarsıntı yaratıyor. "

"Isparta Angle" & "Alanya Massif" is African origin Precambrian age Old Craton.

Alanya Massif
&
SIC Sudbury Igneous Complex
Noril'sk Tunguska Basin

Ni-Co-Cu-Precious Metal Magmatic Sulfide Deposits

Same Primary Ore Mineral formation

Same Other Ore Mineral formation

Similar Petrographic formation

Similar Geologic formation

AEX

AEX ORE MİNERALS (EDS-SEM Analyses)

Table 3.1 Compilation of mineralogy data of ore deposits of the SIC (Ames et al., 2003).

	Mineral	Formula
Primary minerals	pyrrhotite	Fe1-xSx
	pentlandite	(Fe,Ni,Co)9S8
	chalcopyrite	CuFeS2
	magnetite	Fe3O4
Other oxides	ilmenite	FeTiO3
	rutile	TiO2
	cassiterite	SnO2
Other copper minerals	bornite	Cu5FeS4
	cubanite	CuFe2S3
	covellite	CuS
	digenite	Cu9S5
	chalcosite	Cu2S
	talnakhite	Cu9(Fe,Ni)8S16
Sn	stannite	Cu2FeSnS4
	mawsonite	Cu6Fe2SnS8
Zn Cd	sphalerite	(Zn,Fe,Cd)S
	hawleyite	CdS
Other Fe, Ni sulphides	pyrite	FeS2
	Ni-pyrite	(Fe,Ni)S2
	marcasite	FeS2
	bravoite	(Ni,Fe)S2
	Ni-po	(Fe,Ni)x-1Sx
	mackinawite	Fe9S8 (tet.)
	violarite	(Fe,Ni)3S4
	polydymite	NiNi2S4
	millerite	NiS

SUDBURY ORE MİNERALS

PRECIOUS METAL MINERALS (Under İnvestigation)	native Ag	Ag
	Ag-pn	Ag(Fe,Ni)8S8
	hessite	Ag2Te
	empressite	AgTe
	stuetzite	Ag5-xTe3
	dyscrasite	Ag3Sb
	acanthite	Ag2S
	naumannite	Ag2Se
	matildite	AgBiS2
	bohdanowiczite	AgBiSe2
	volynskite	AgBiTe2
Au	electrum	AuxAg
	native Au	AuxAg
PGE MINERALS		
Sn	stannopalladinite	Pd2Sn2
	niggliite	PtSn
Sb	stibiopalladinite	Pd5Sb2
	sudburyite	(Pd,Ni)Sb
	mertieite II	Pd8(Sb,As)3
	geversite	PtSb2
As	sperrylite	PtAs2
	hollingworthite	RhAsS
	irarsite	IrAsS
	ruarsite	RuAsS
Bi	insizwaite	Pt(Bi,Sb)2
	froodite	PdBi2
	sobolevskite	PdBi
	polarite	Pd(Bi,Pb)
BiTe	maslovite	(Pt,Pd)(Bi,Te)2
TeBi	moncheite	(Pt,Pd)(Te,Bi)2
TeBi	michenerite	PdBiTe
TeBi	merenskyite	(Pd)(Te,Bi)2
Te	keithconnite	Pd3-xTe
Te	kotulskite	PdTe
	melonite	NiTe2
ALTERATION MINERALS	hematite	Fe2O3
	limonite/go	FeOOH

NORIL'SK ORE MİNERALS

Under Investigation

Main	Major	Rare (PGM)
Chalcopyrite $CuFeS_2$	Bornite Cu_5FeS_4	Majakite PdNiAs
Pentlandite $(Ni,Fe,Co)_9S_8$	Chalcocite Cu_2S	Palladoarsenide Pd_2As
Cubanite $CuFe_2S_3$	Pyrite FeS_2	Stillwaterite $(Pd,Ni)_8As_3$
		Zvyagintsevite Pd_3Pb Plumbopalladinite Pd_3Pb_2 Polarite Pd(Pb,Bi)
Pyrrhotite $Fe_{1-x}S$	Magnetite $FeFe_2O_4$	Rustenburgite $(Pt,Pd)_3Sn$
	Violarite $FeNi_2S_4$	Atokite $(Pd,Pt)_3Sn$
	Sphalerite ZnS	Taimyrite $(Pd,Cu,Pt)_3Sn$
	Galena PbS	Stannopalladinite Pd_5Sn_2Cu
		Auricupride $Cu_3(Au,Pd)$
		Tetra-auricupride Cu(Au,Pd)
		Cu-Au-Ag alloys
		Guanglinite Pd_3As
		Sobolevskite PdBi

Two outstanding Ni-Co-Cu deposits in the World Sudbury, Canada & Noril'sk, Russia

MAIN MİNERAL : PYRRHOTİTE 4C Monoclinic

Ni-Co-Cu-Au-Ag-PGE Magmatic Sulfide Deposits Major Main Mineral :
PYRRHOTITE 4C

Sudbury–Canada and Norilsk–Russia ores is magmatic sulfide formations their Nickel, Cobalt, Copper, Au, Ag, PGM contents and they contain large amounts of Iron and Sulphure. Main mineral is Pyrrhotite, chemical combination of iron and sulfur. Pyrrhotite is ubiquitous in the ores of the Sudbury - Norilsk district and is the major sulphide composing the massive and disseminated ores in the main deposits.

Pyrrhotite, which is formed with minerals containing Nickel, Cobalt, Copper and PGE, is of economic importance and Fe and S are generally produced as by-products in this type of deposits.

When pyrrhotite is affected by surface conditions, sulfur minerals react with water and oxygen to transform into Iron oxide (Magnetite-Hematite) and Iron hydroxide (Goethite) minerals, which is why it is very difficult to find in geochemistry and surface surveys.

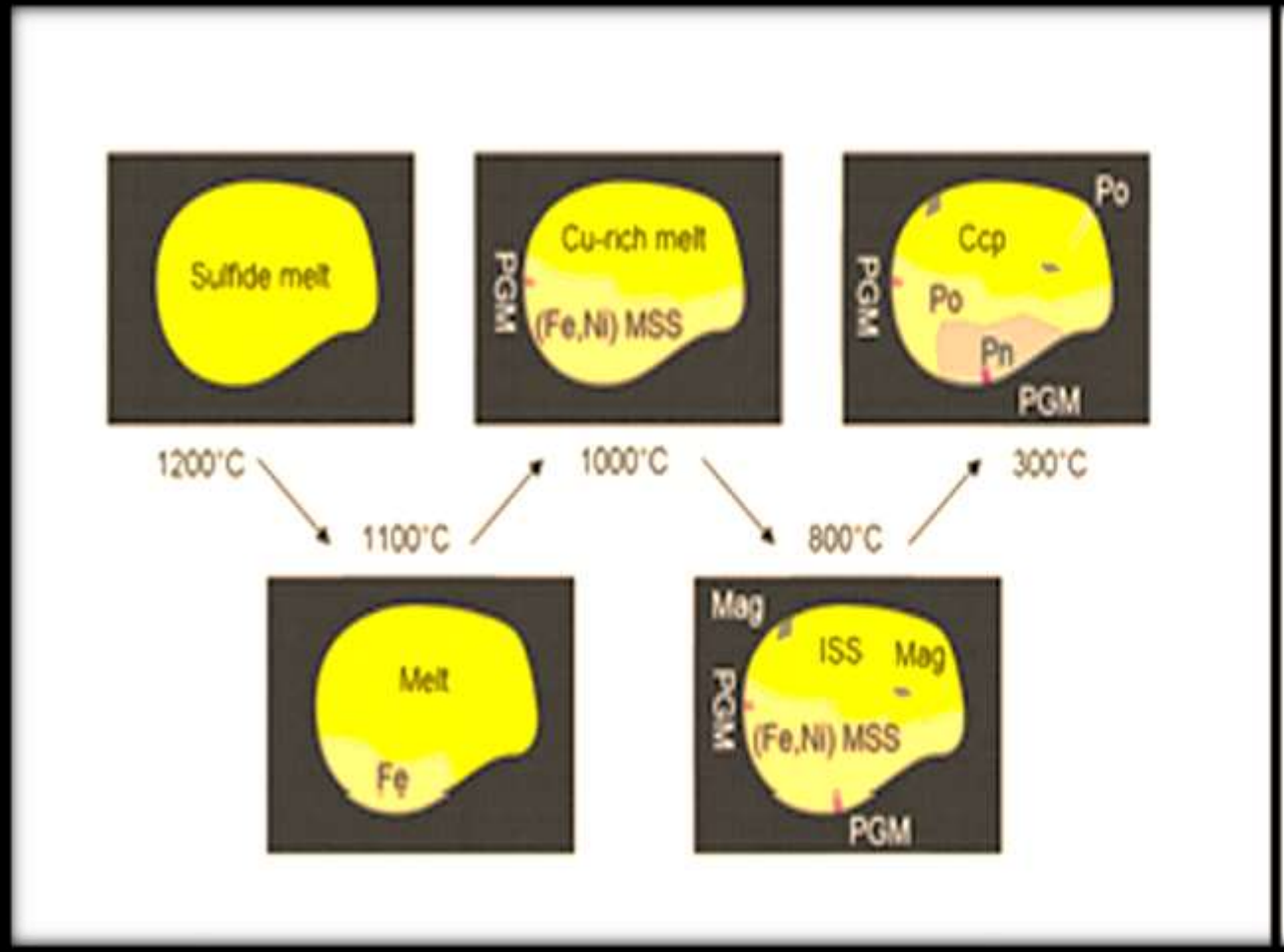
Pyrrhotite, which has 6 different crystal structures, has a high Ferromagnetic property type 4C.
PYRRHOTITE 4C (Fe_7S_8) is in monoclinic crystal structure and is the most important type.

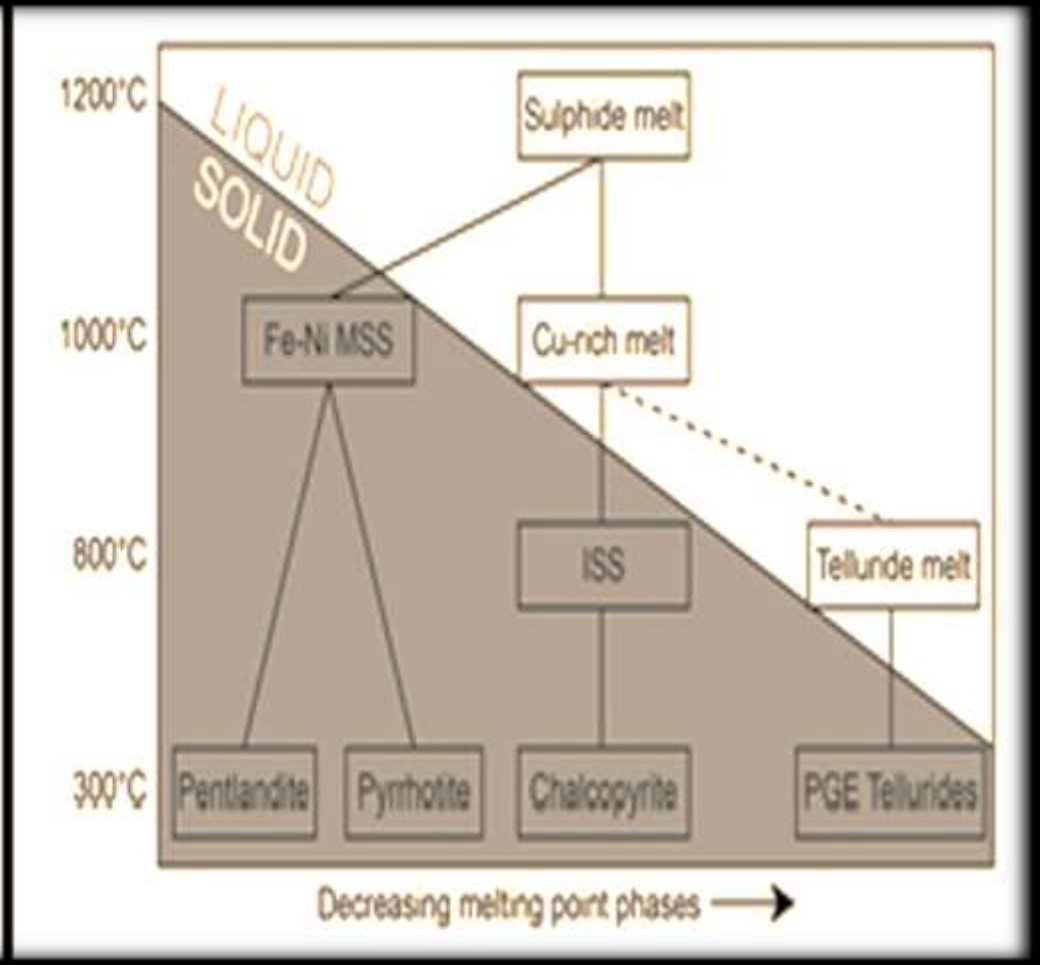
Crystallography of Pyrrhotite

Pyrrhotite-11C	Pyrrhotite-11H	Pyrrhotite-4C	Pyrrhotite-5C	Pyrrhotite-6C	Pyrrhotite-7H
$Fe_{10}S_{11}$	$Fe_{10}S_{11}$	Fe_7S_8	Fe_9S_{10}	$Fe_{11}S_{12}$	Fe_9S_{10}
Orthorhombic	Hexagonal	Monoclinic	Monoclinic	Monoclinic	Hexagonal

Pyrrhotite-Pentlandite-Chalcopyrite

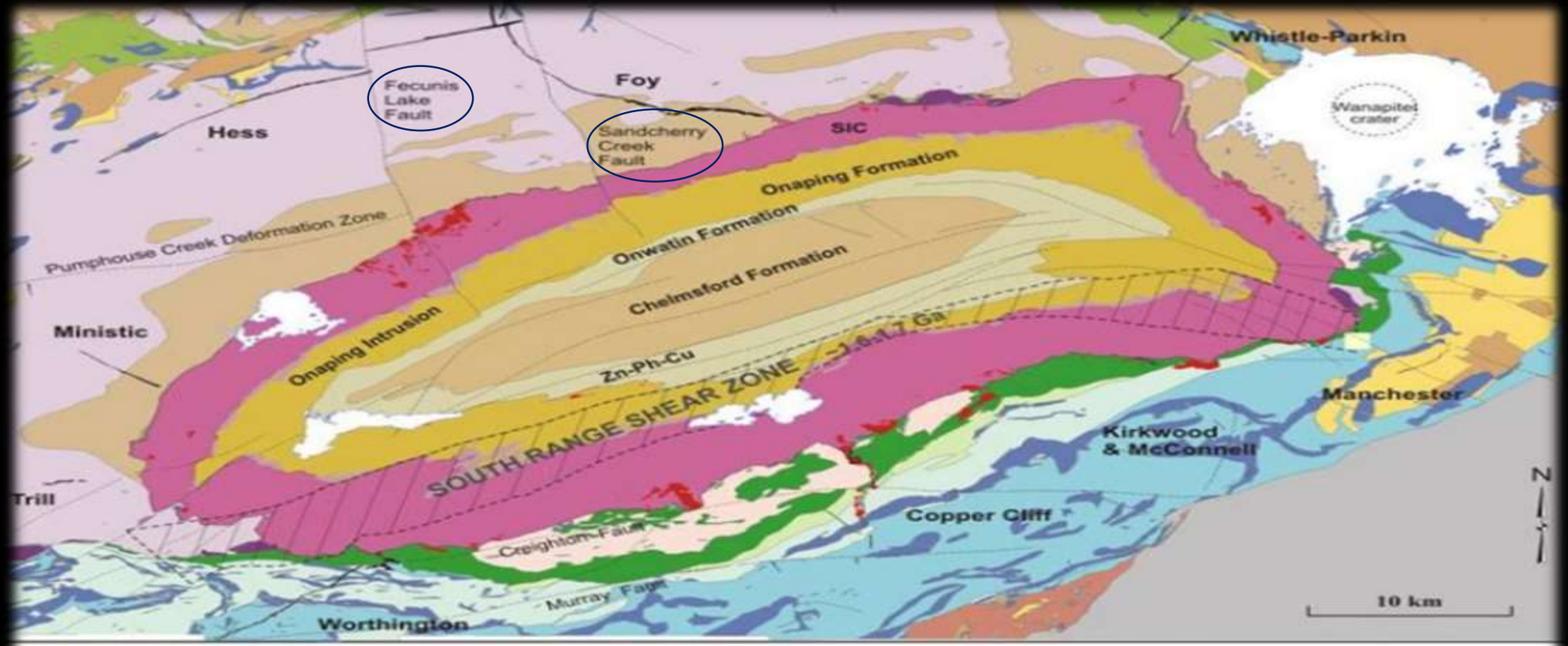
Ref: The Sudbury-Noril'sk Symposium
http://www.geologyontario.mndmf.gov.on.ca/ mndmfiles/pub/data/imaging/SV05/SV05.pdf





Sulfides are accessory phases in all types of mantle xenoliths.
The major sulfide phases present in mantle rocks are pyrrhotite ,pentlandite and chalcopyrite.
Also present are the 'monosulfide solid solution' (mss) and 'intermediate solid solution' (iss) phases.
The observed mineralogy of mantle sulfides, however, likely represents low temperature (<300 °C) .

SIC Sudbury Igneous Complex



SIC Sudbury Igneous Complex

Birthplace of a World Famous Mining District

● Sudbury area a world class mining district hosts of the world's largest Ni-Cu-PGE magmatic sulphide deposits.

● The Greater Sudbury area is an astonishingly rich mining district. By every measure it is huge.
The district has produced more than 8 million tonnes each of nickel and copper, and over 3200 tonnes of silver, 300 tonnes of platinum and 100 tonnes of gold.
Based on today's metal prices, more than 77 mines have produced an estimated CDN$ 500 billion worth of metal in the past century.

● From the late 1920s until around 2000, all significant magmatic sulphide deposits of the Sudbury Structure were the property of either INCO Ltd (now VALE INCO) or Falconbridge Ltd. (now XSTRATA-GLENCORE).

● The first mineralization in the area was discovered by a surveyor (1856) and described by Murray (1857) of the Geological Survey of Canada. Several decades later the site was found to lie only 200 m west of the open pit of the Creighton Mine (Giblin 1984). The first discovery of mineralization, which led to the development of a mine, was made in 1883 during construction of the Canadian Pacific Railway. A rail-cut exposed high grade mineralization, which was later (1884) developed as the Murray Mine. By 1999, after 112 years of exploration, approximately 116 deposits have been found.

Noril'sk–Talnakh Cu–Ni–PGE deposits: a revised tectonic model

Alexander Yakubchuk - Anatoly Nikishin

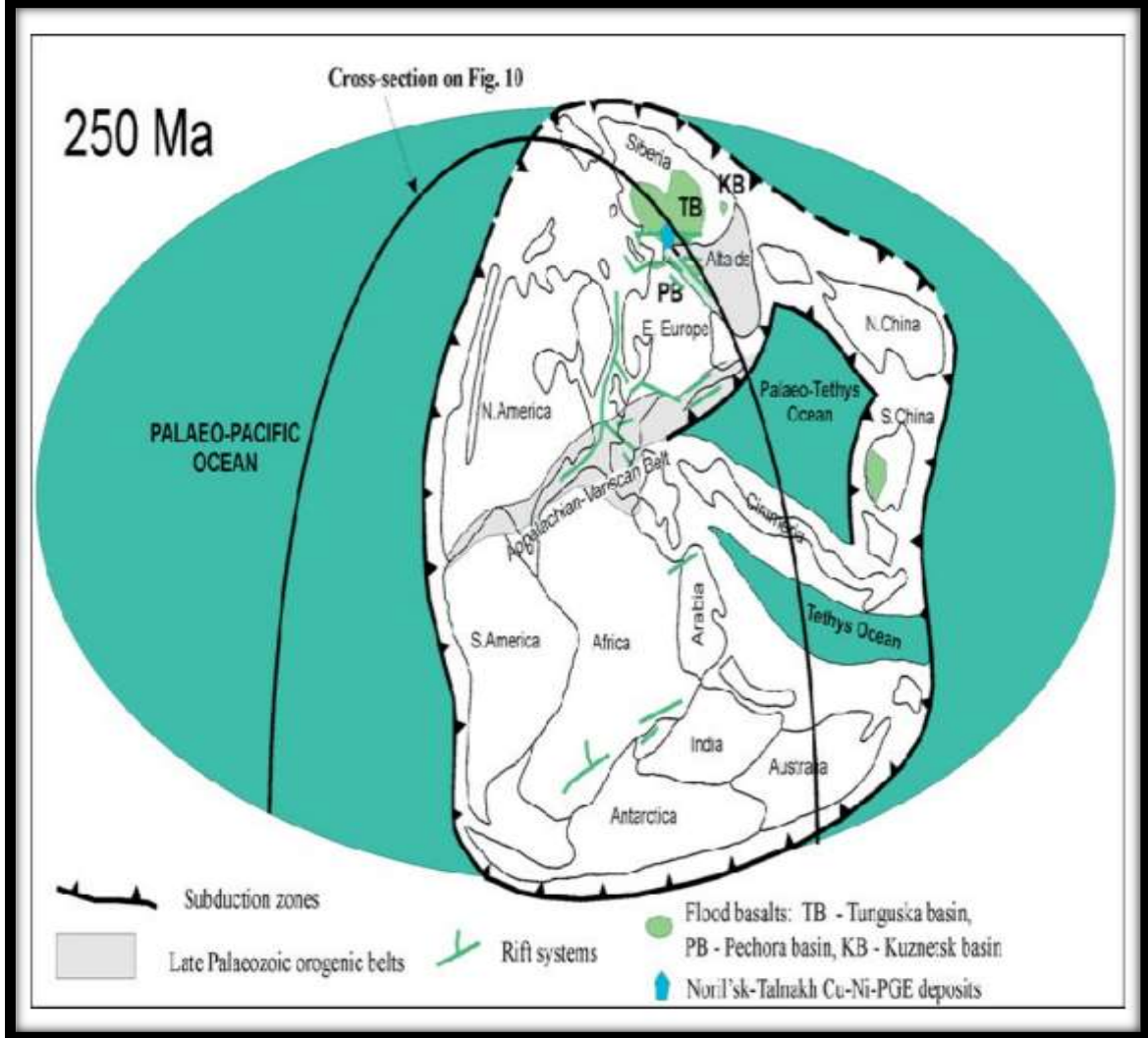


Fig. 9 Permo-Triassic (250 Ma) reconstruction (simplified after Scotese and McKerrow) showing location of major continental rifts, flood basalt provinces and related Cu–Ni–PGE mineralization

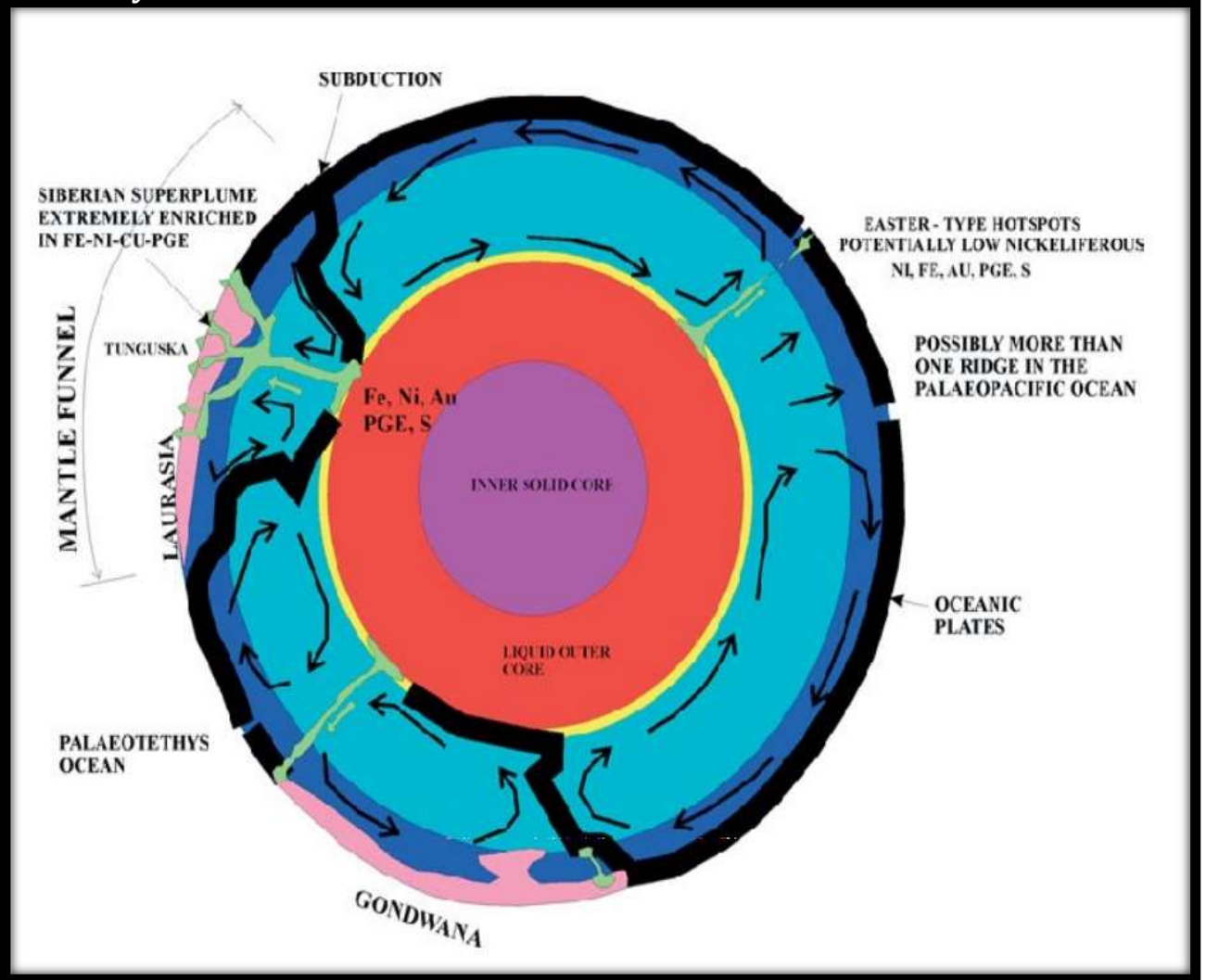


Fig. 10 Possible structure of the Earth at the Permian– Triassic transition. We suggest the presence of a whole-mantle subduction funnel under Laurasia, which might stimulate focused ascent of the Cu–Ni–PGE-rich mantle plume (green) in the geometric centre of the continent. Black arrows show possible convection in the mantle

NORIL'SK

• The origin of Ni,Cu,PGE sulfide deposits of Noril'sk and Talnakh located in the northwest flank of the Triassic basalt trap formation of Siberia is considered. It is shown that ore elements of these deposits (probably, except Fe) are derived from the crust rather than from the mantle. They entered the basalts owing to a remobilization (recycling) of ore elements from the Paleoproterozoic sediments and from the rocks of the Siberian platform's basement.

• Prospecting criteria for similar deposits are as follows:
(1) a presence of a large Paleoproterozoic aulacogen and a related magmatic sulfide Cu,Ni mineralization;
(2) a confinement of perspective areas to troughs associated with long-lived deep fault zones;
(3) association with mobile orogenic belts, island-arc systems and tectonomagmatic activation zones;
(4) temporal association with boundaries of global periods characterized by active processes of continental breakup and large-scale trap magmatism.
A combination of several factors (the first one is obligatory) is favorable for the discovery of a large ore body

• The deposits of the Noril'sk region have developed within flat, elongate bodies (15 X 2 X 0.2 km) that intrude argillites, evaporites and coal measures, adjacent to a major, transcrustal fault and immediately below the centre of a 3.5 km-thick volcanic basin. An anticlinal axis that transects the axis of the basin at a high angle has brought these intrusions to surface to give rise to the two major ore junctions, Noril'sk and Talnakh.

• When most major Ni-Cu sulfide deposits, the light of studies at Norilsk, Sudbury, three factors become apparent:
(i) the concentration of sulfides in channels or conduits through which much magma has flowed (feeder conduits for intrusions are much more prospective targets for exploration than the base of the intrusions themselves);
(ii) the interaction of the source magma with country rocks, either leading to the incorporation of sulfur, or the felsification of the magma in question; and
(iii) fractional crystallisation of sulfide liquid giving rise to Cu-rich ores which may be far removed from the 'source' ore.

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