



# SMEDG

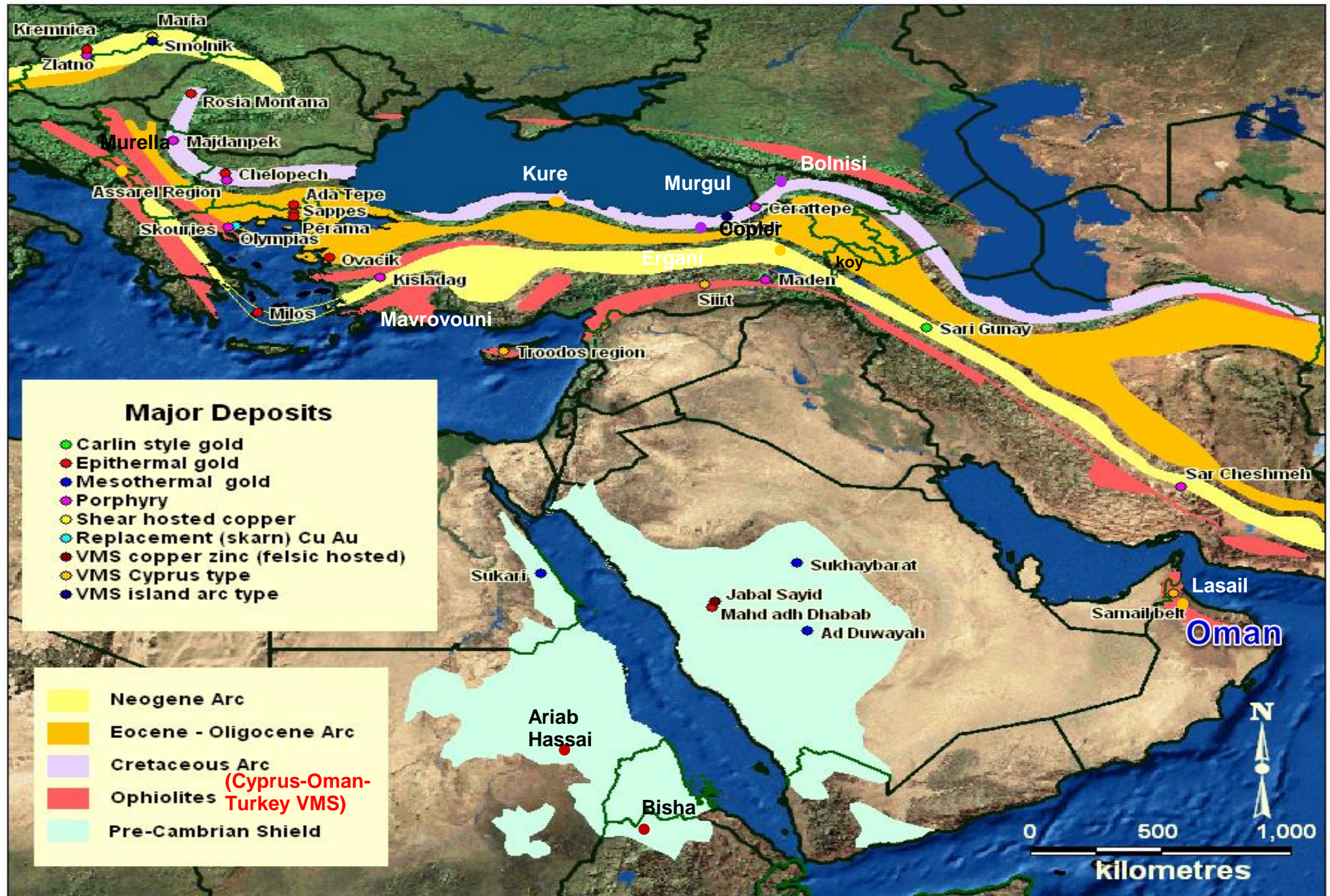
SYDNEY MINERAL EXPLORATION DISCUSSION GROUP

# Exploration for Ophiolitic Besshi-type VMS deposits in Turkey

By Robert Close  
January 2018



# Western Tethyan Orogeny - Regional Metallogeny 2011



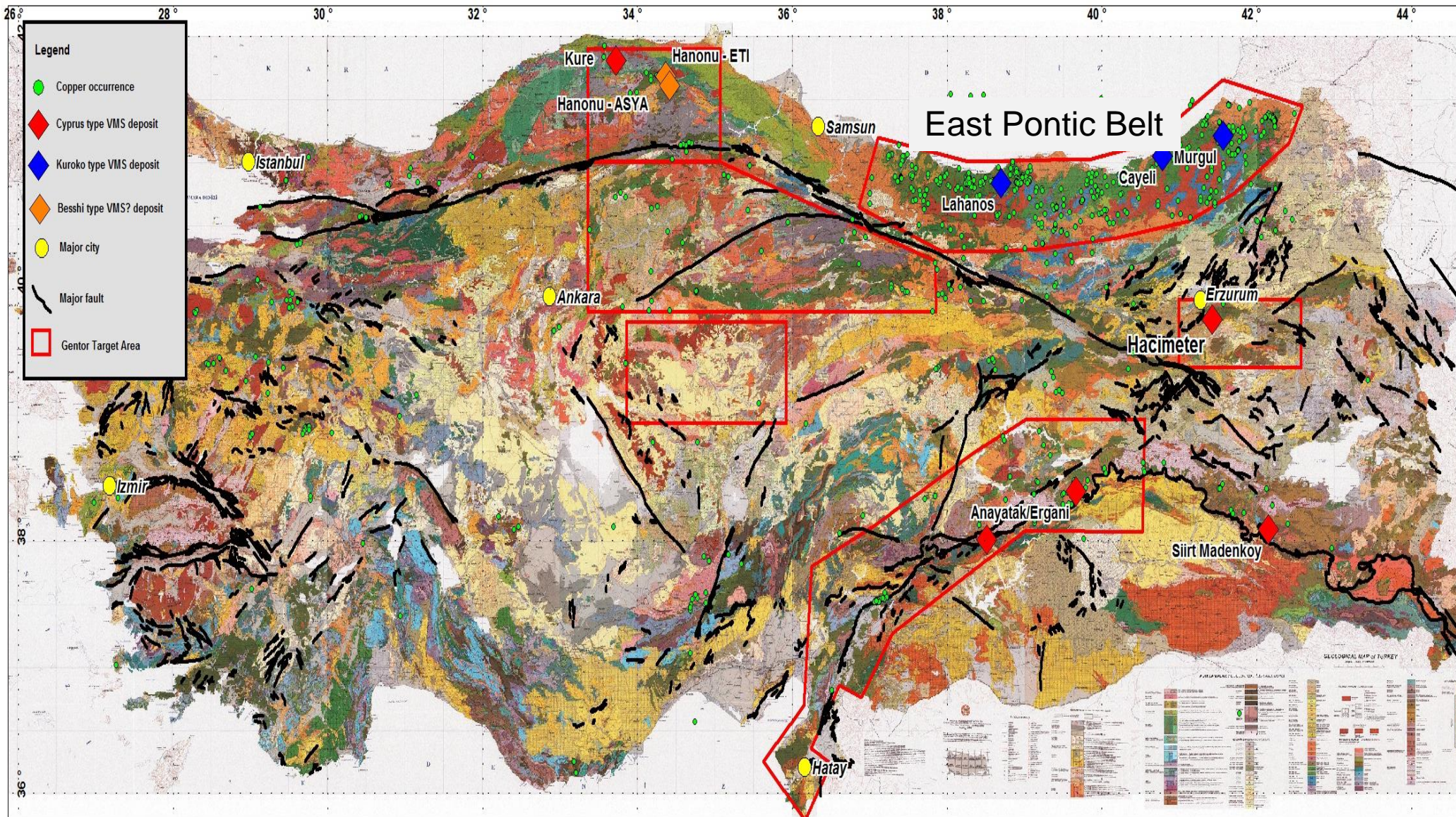
# **Gentor's 2012 Turkey Strategy**

- **Gentor had global VMS expertise and recognised major exploration potential in Turkey for Cyprus, Besshi and Kuroko-type VMS deposits.**
- **Mesozoic to Tertiary Ophiolitic and Island arc settings are widely distributed in Turkey and most have not received intensive modern exploration.**
- **Turkey hosts at least six +20Mt world class VMS Cu deposits within five prospective volcanic terrains that Gentor initially selected for review.**
- **Most of these Ophiolitic terrains had not been a prime target for international or local VMS investment due to perceived low potential for major Cu deposits.**
- **Gentor's focus was the Central Pontide Region due to large new discoveries of both Cyprus & Besshi type deposits, and potential license area availability.**
- **Gentor intended to acquire key tenement coverage within several priority target areas by the end of 2012 and develop strategic relationships with Turkish partners to accelerate their exposure to significant new deposits.**
- **Proceed to explore and delineated sufficient resources to establish feasibility for mining development by 2015.**



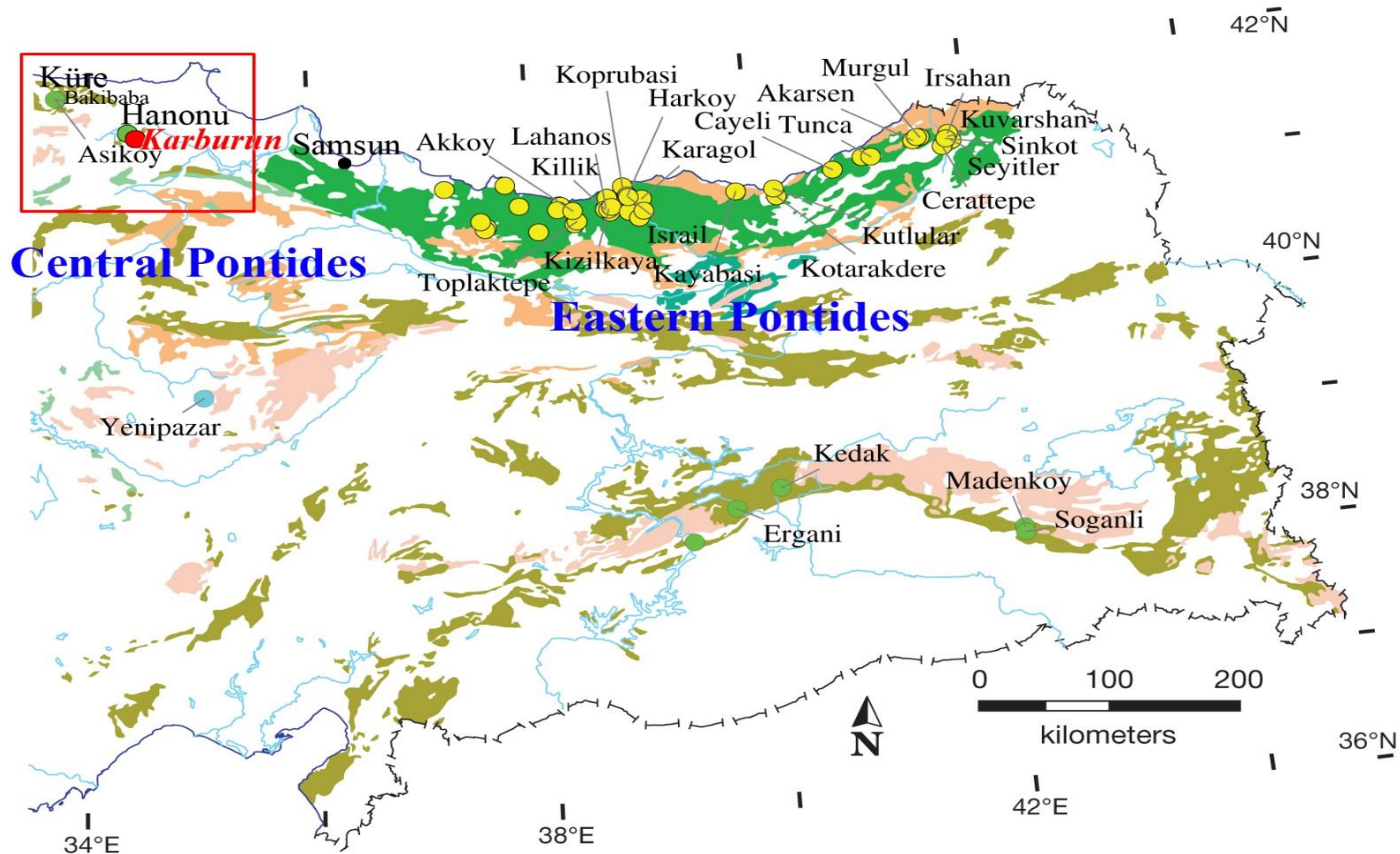
# VMS Copper Targets in Turkey

## - Gentor Resources 2011





# Central & Eastern Pontides VMS Deposits



## Explanation

### Submarine Volcanic Rocks

	Eocene
	Upper Cretaceous-Eocene
	Upper Cretaceous
	Jurassic-Cretaceous

### Ophiolite and Ophiolitic Melanges

	Mainly Jurassic-Cretaceous
	Metamorphic Rocks
	Pre-Mesozoic
	Undifferentiated

### VMS Deposits

	Kuroko-type
	Cyprus-type
	Metamorphosed VMS

From Yigit, O. 2009. Economic Geology



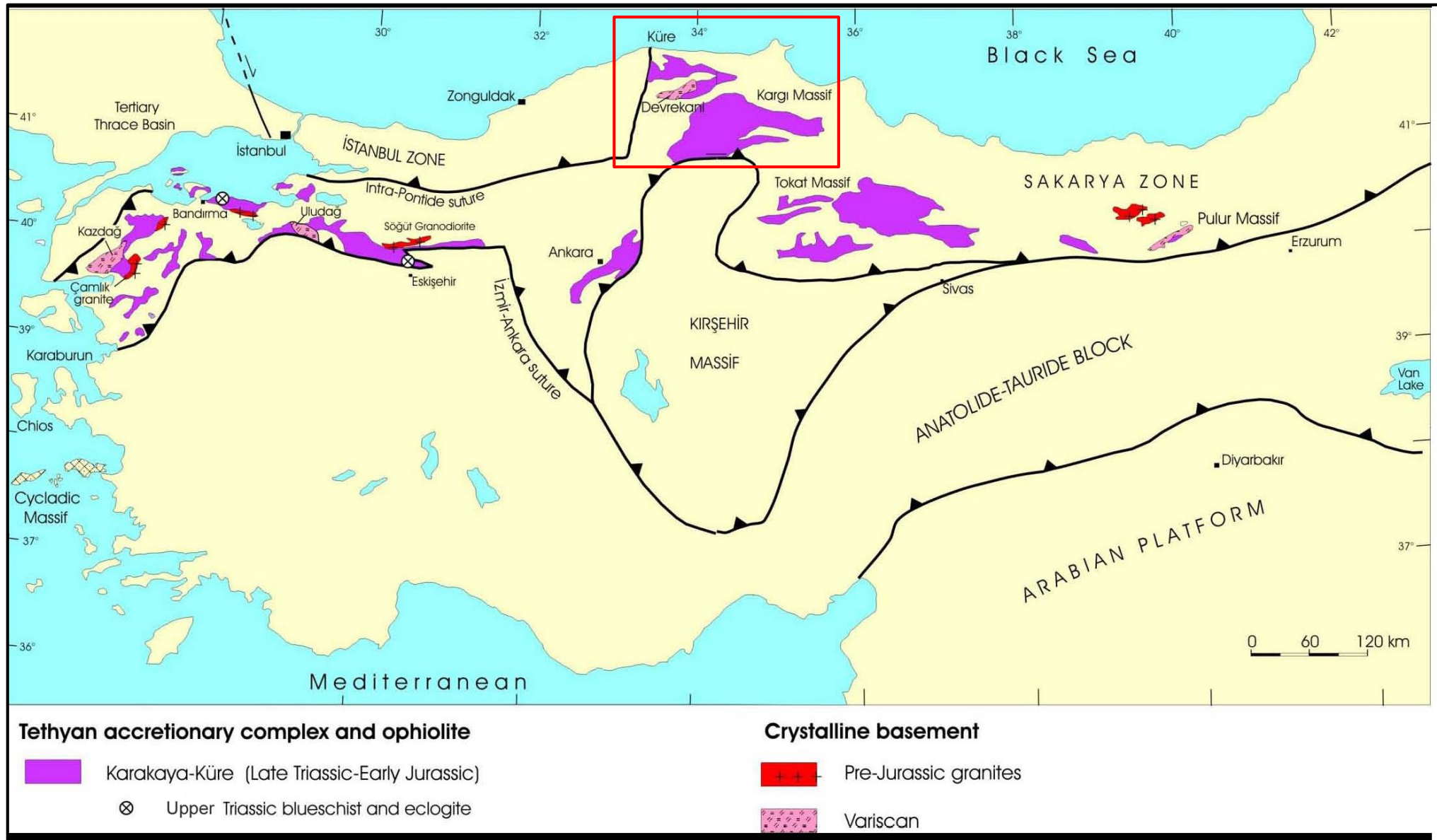
# Western Tethyan Orogeny – Structural Blocks



**From Aral Okay - Orogenic Episodes in the Pontides . AAPG European Region Annual Conference**  
October 17-19, 2010, Kiev, Ukraine



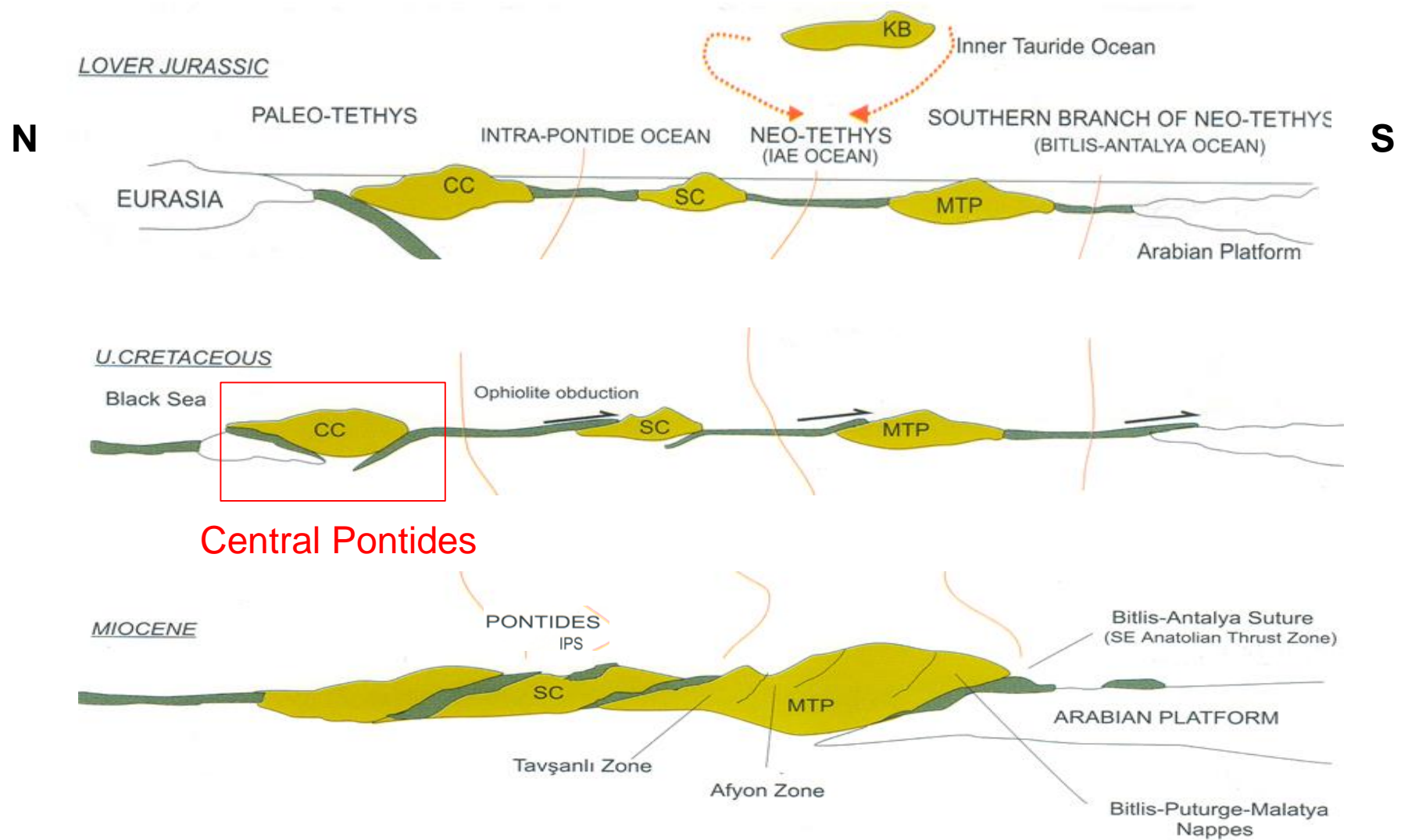
# Tethyan Pre-Tertiary Ophiolites and Accretionary complexes in the Sakarya Zone



Okay, A. 2010. Orogenic Episodes in the Pontides . AAPG European Region Annual Conference,

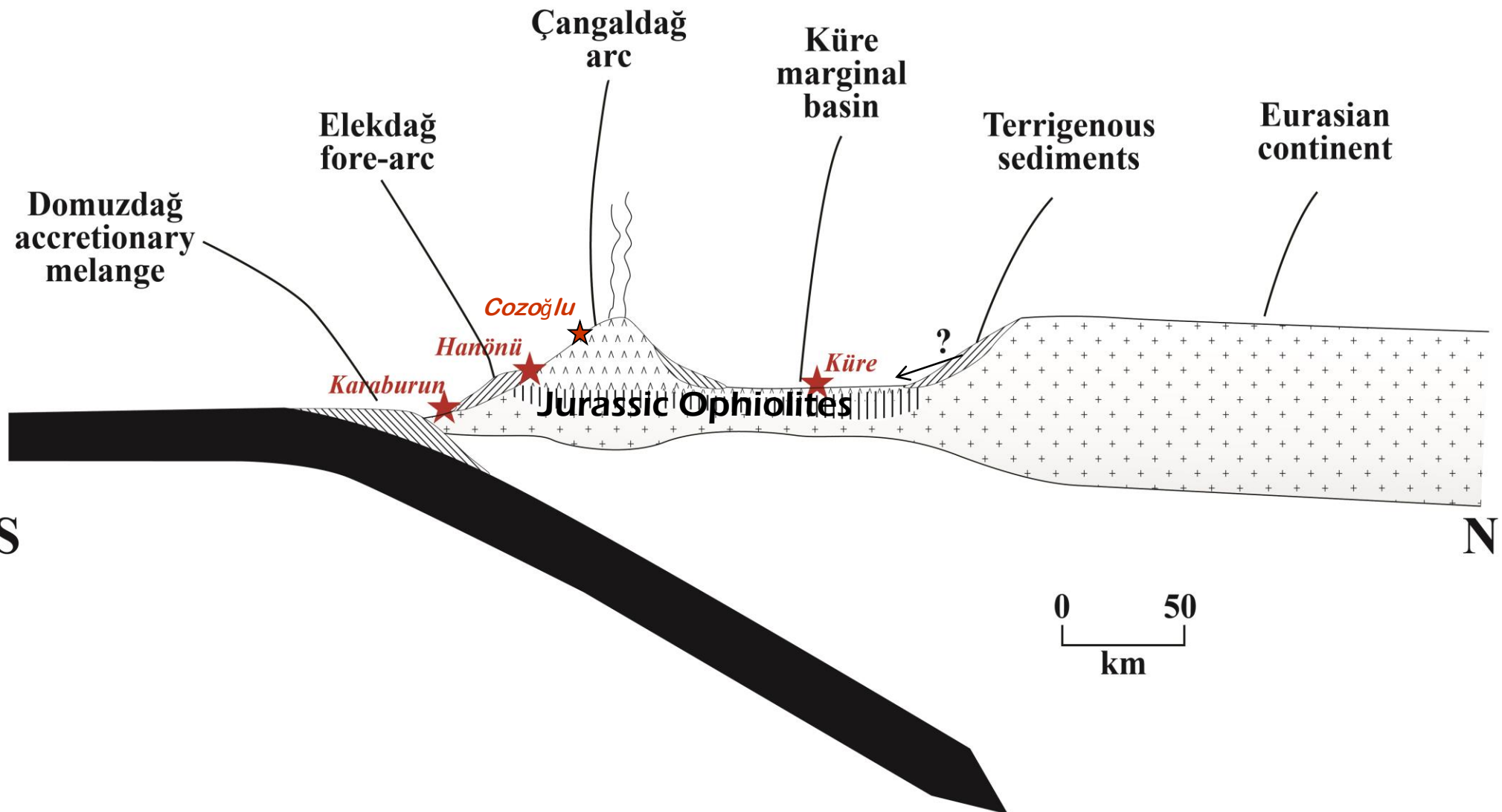


# Pontide Tectonics – multiple accreted Island Arcs and Ophiolitic Mélanges





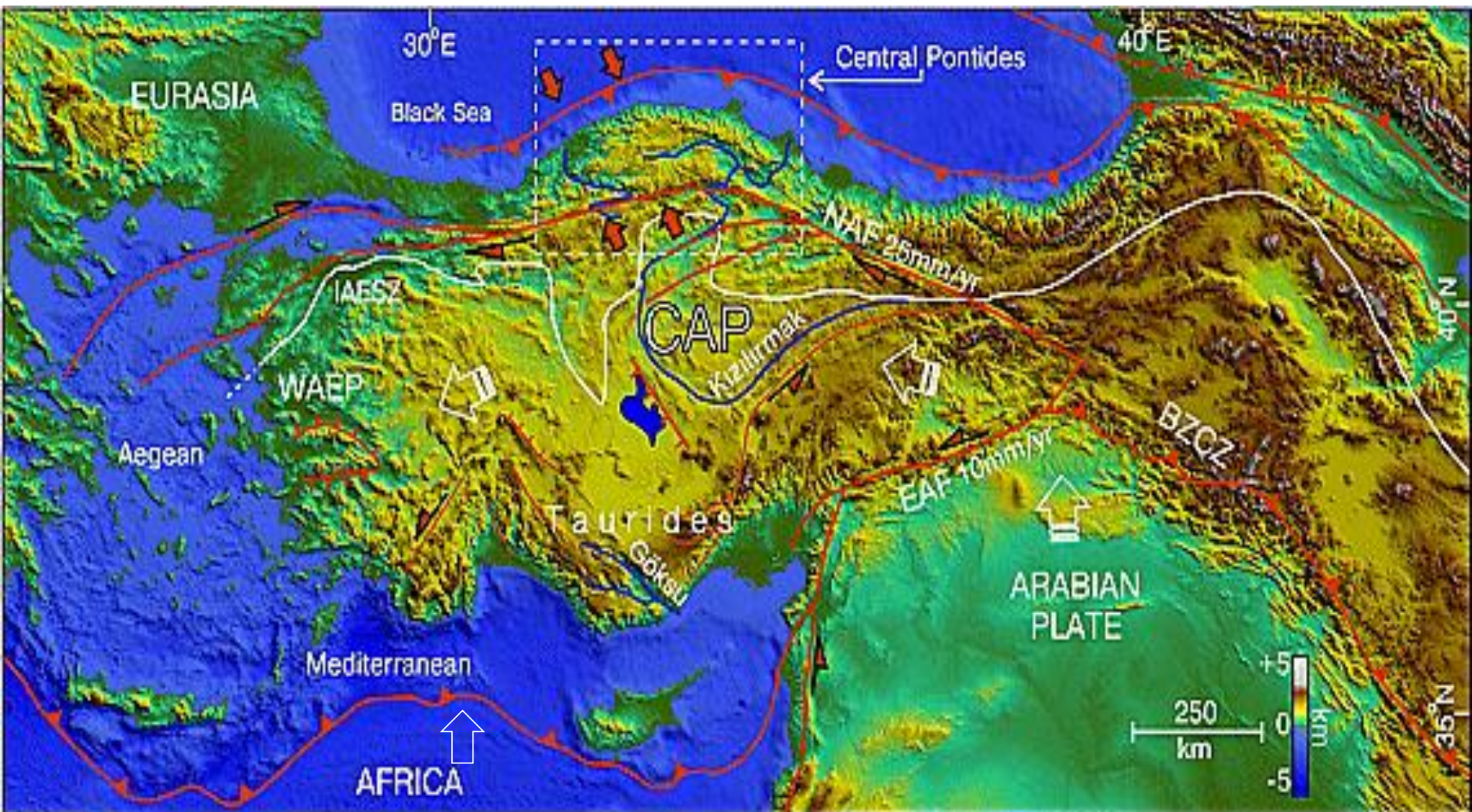
# Central Pontides Cretaceous Tectonic model – VMS Deposit Locations





# Late Neogene Tectonic map - Western Tethyan region.

Note active orogenic uplift in the Central Pontides associated with the North Anatolian Fault





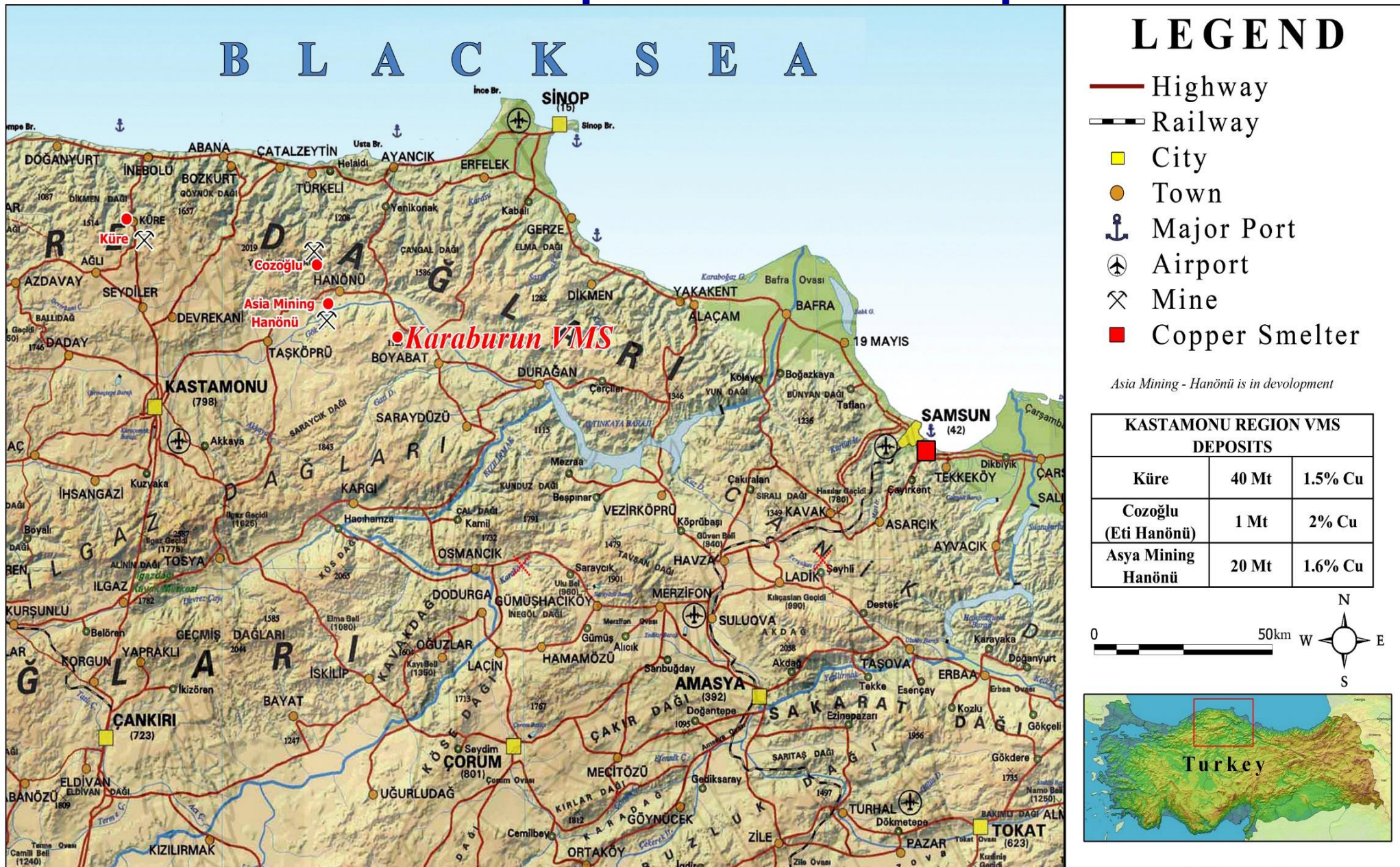
# Relevance of the Central Pontides?

The Central Pontides represent a prime relatively under explored target for Ophiolitic Cyprus-Besshi type VMS deposits with several large Jurassic copper deposits known in the north:

- **Küre Mine (*Eti Bakir*) – 40Mt @ 2.0% Cu – in UG production**
- **Hanönü (*Asya Maden*) – 30Mt @ 1.56% Cu – in UG development**
- **Large areas of undifferentiated Mesozoic supra subduction zone ophiolitic melanges to the south are considered to be VMS prospective.**
- **Gentor reconnaissance has identified several “new” gossan discoveries in these terrains near Hanönü, so the potential for further large deposits in the region is high.**
- **Excellent regional infrastructure (*highway access, power, manpower, communication, water, town and village accommodation*)**
- **Asya Mining copper concentrator nearby at Hanönü and the Eti Bakir Copper Smelter & Refinery 150km away at Samsun on Black Sea coast.**

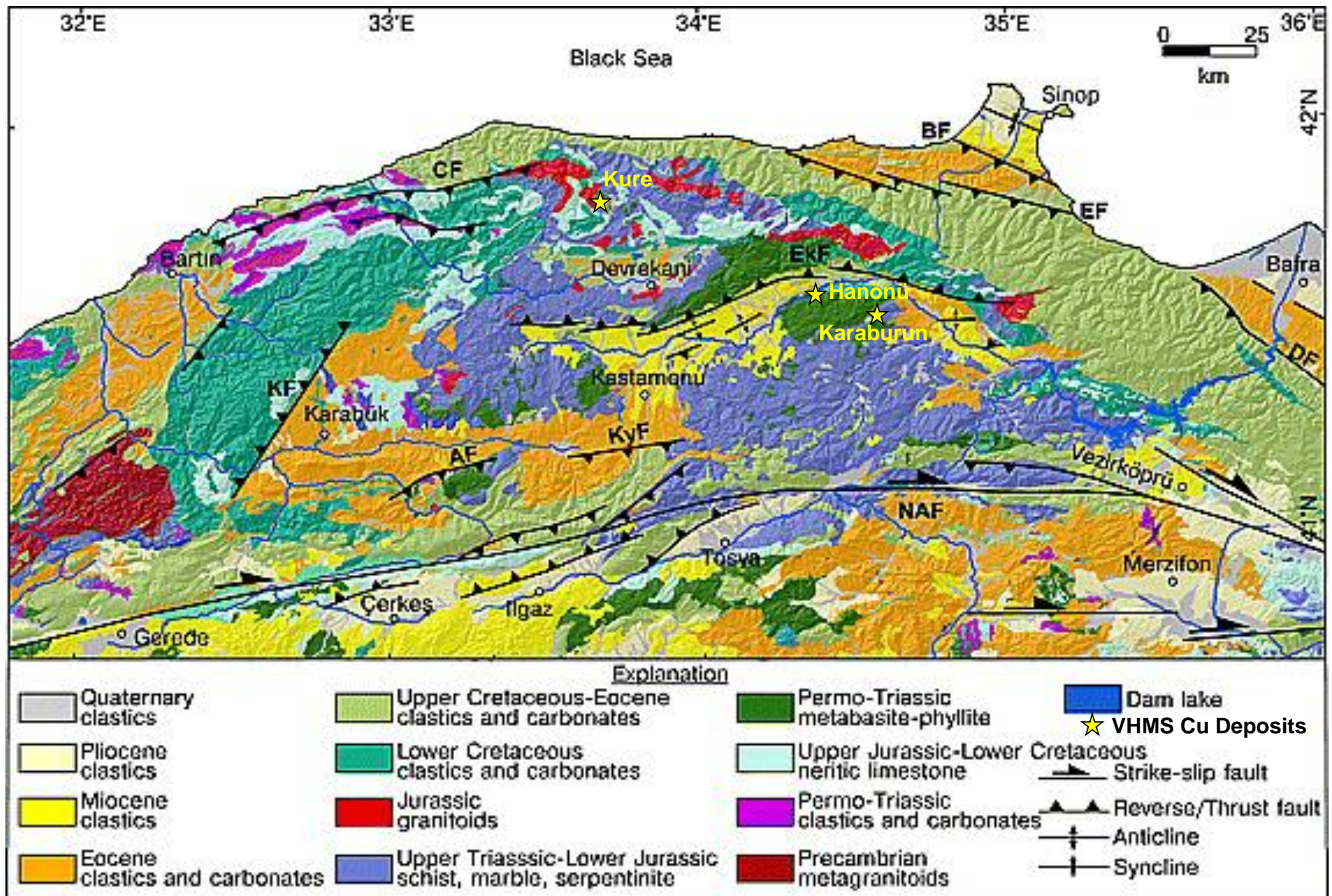


# Central Pontides -Topography, Infrastructure and VMS Deposit Location Map



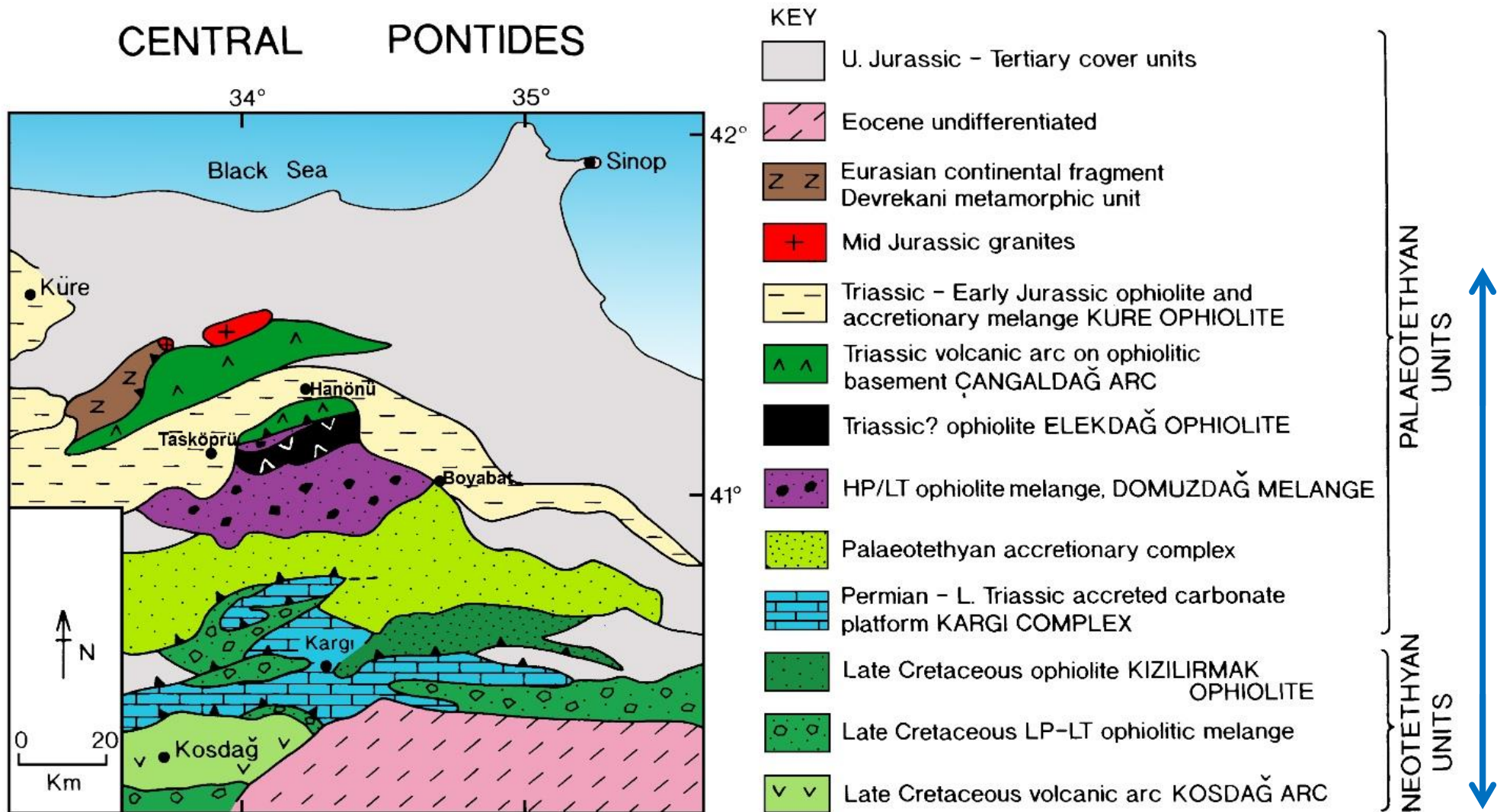


# Simplified Regional Geology of the Central Pontides





# Central Pontides – Prospective VMS Stratigraphy



From Robertson A, 2002

# Central Pontide VMS Deposit Models

**The Central Pontide region** lies within the Intra-Pontide Sakarya Suture Zone of northern Turkey. The prime VMS terrain in this region comprises early Tethyan Triassic-Jurassic volcanic arcs and Ophiolites with associated mélanges, and an accretionary complex consisting of a thick extensive metamorphosed mafic volcanic and schistose sedimentary sequence.

**The main prospective sequence is the 2,000m thick Bekirli Formation, part of the Domuzdag Melange and equated with similar sequences in the Çangaldag volcanic arc to the north.**

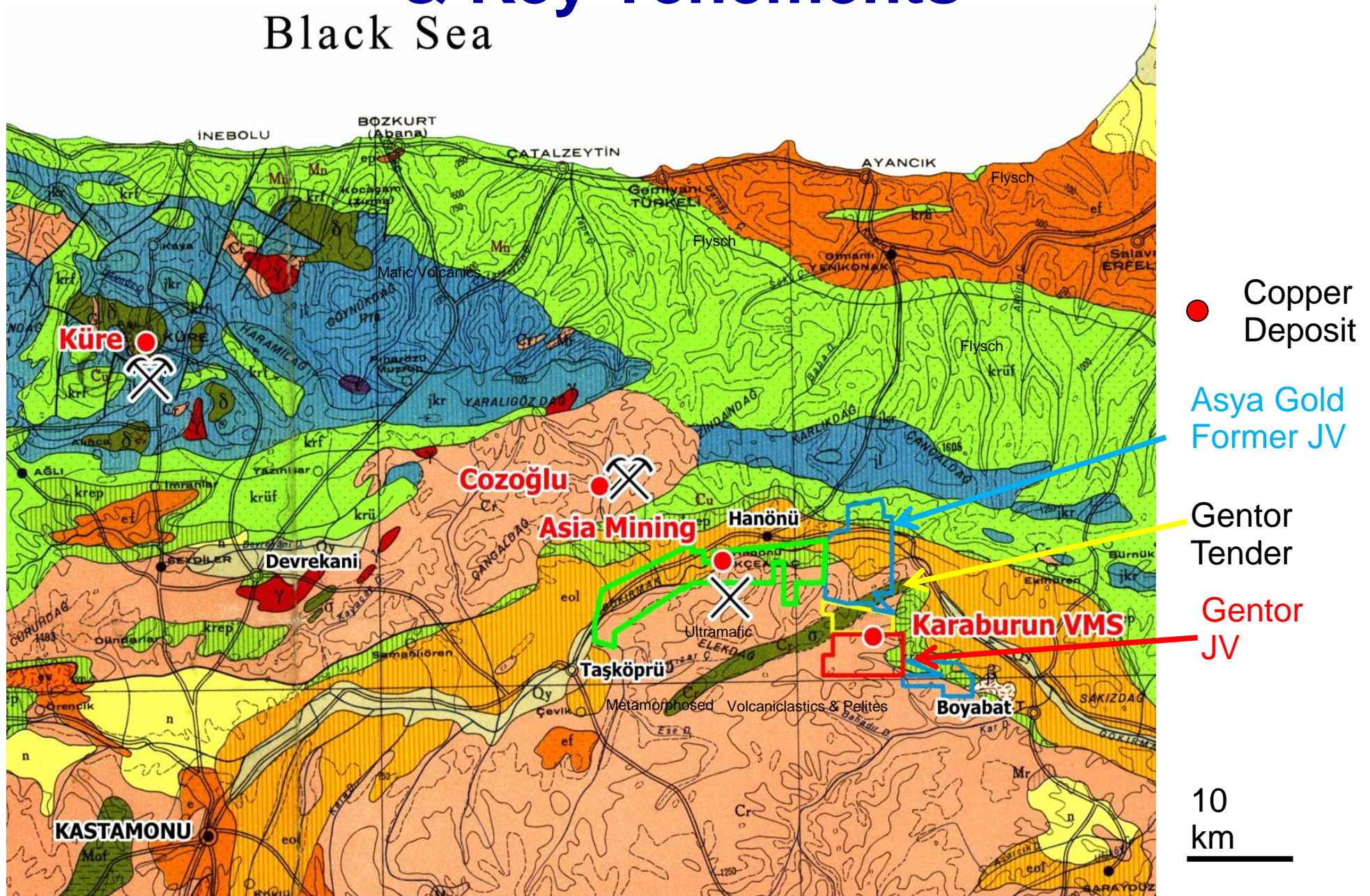
Two Cu-rich VMS deposit models are prospective in this region:

- **Ophiolitic mafic volcanic dominated proximal Cyprus-type setting (e.g., Küre Complex)**
- **Sediment dominated distal mafic volcanic Besshi/Kieslager-type setting (e.g., Hanönü Çangaldag volcanic arc ).**



# Central Pontides – VMS Deposits & Key Tenements

Black Sea



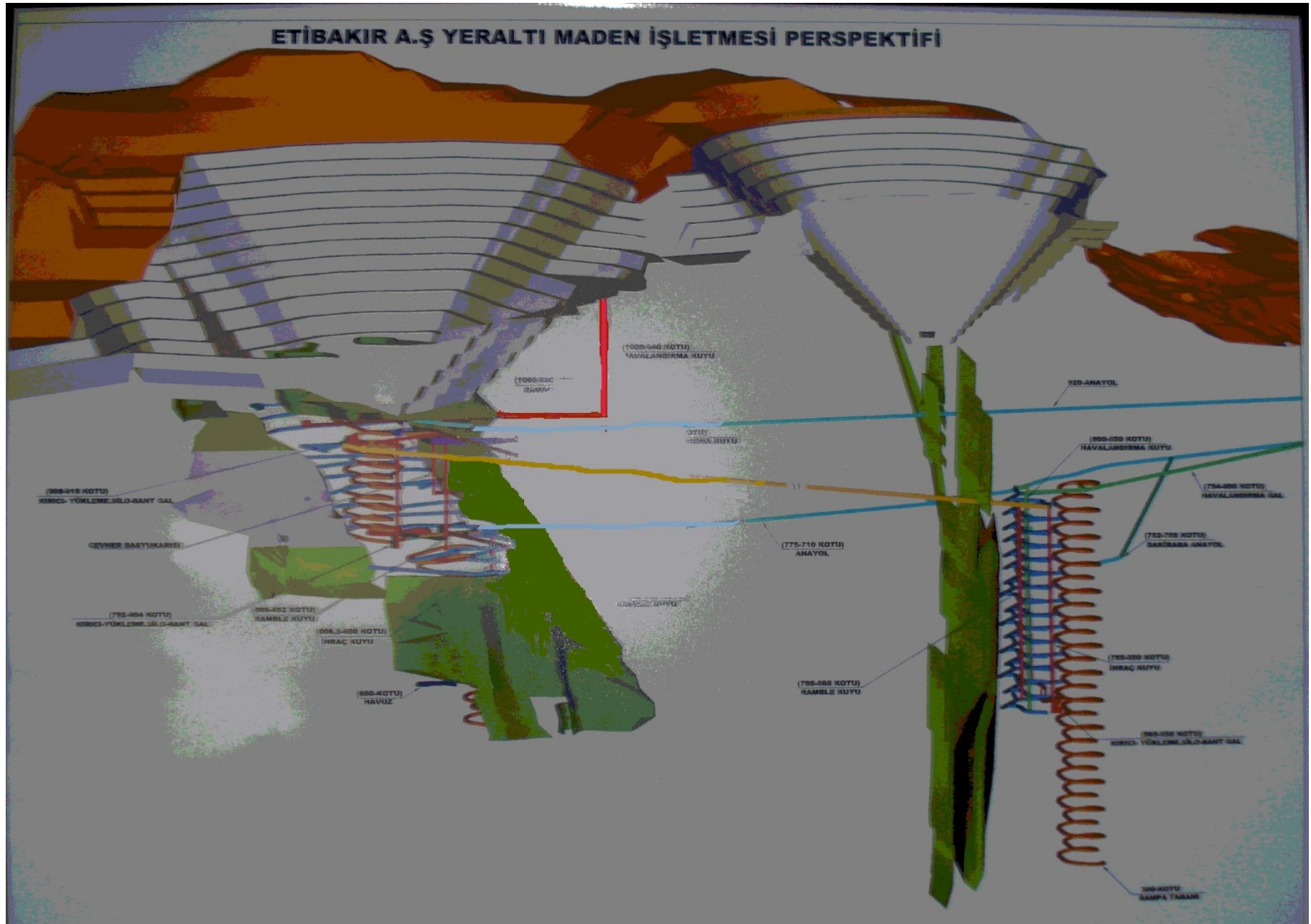


# Küre town and copper mine 2012



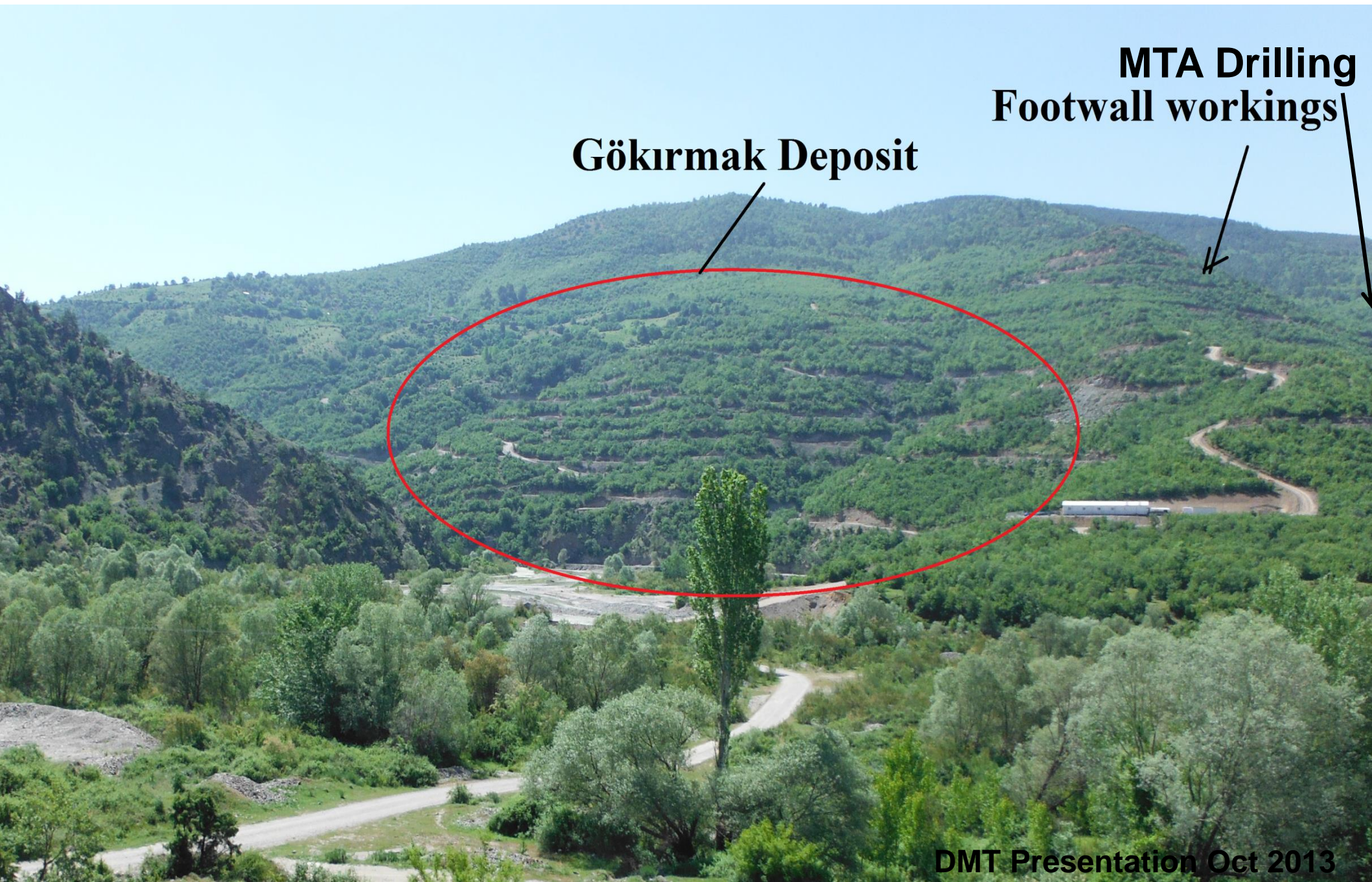


# Küre Mine Development 2012





# Hanönü Project site 2013



**Gökırmak Deposit**

**MTA Drilling  
Footwall workings**



# Hanönü Deposit - Roman workings in footwall MS lodes at Üvezlidere



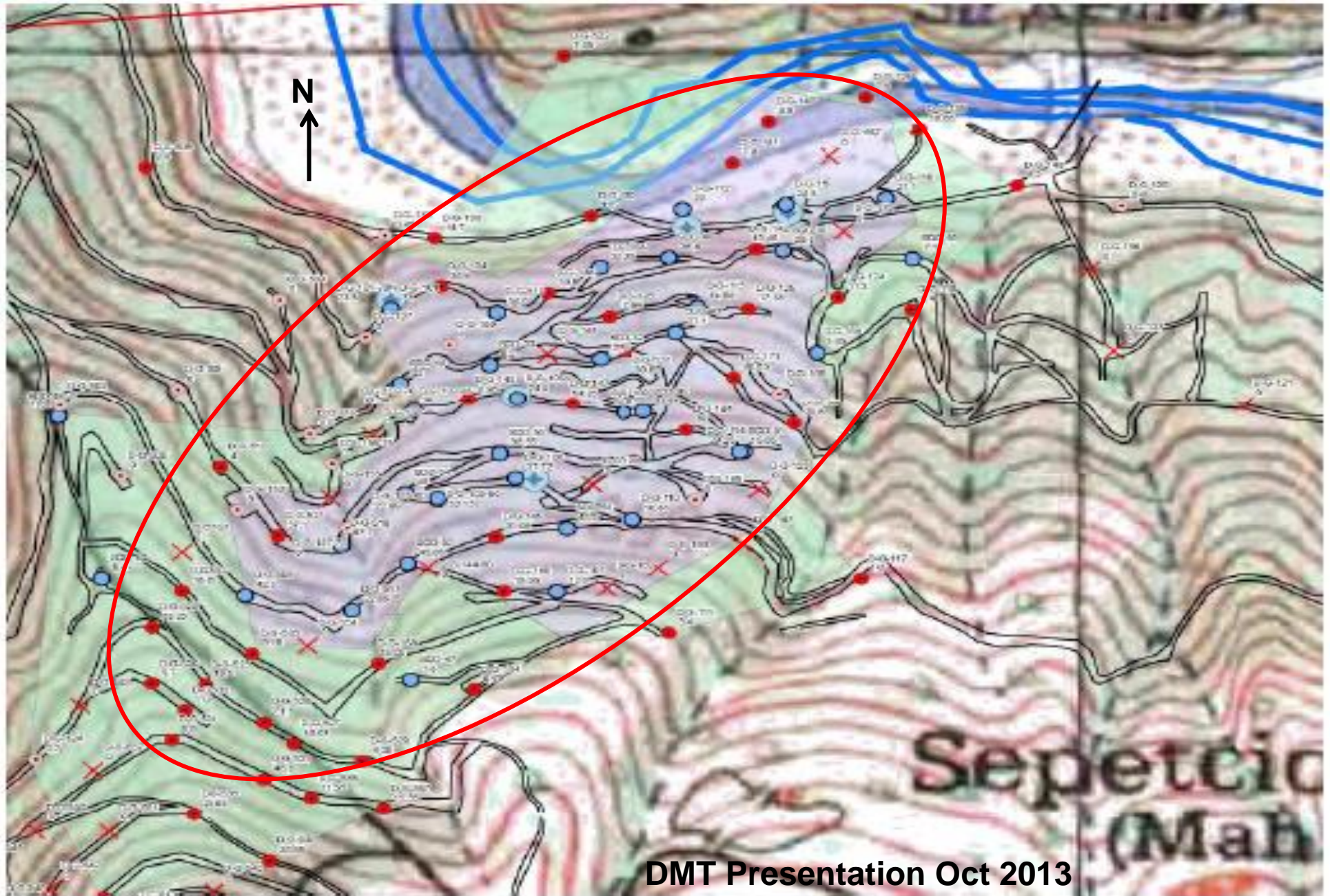


# Hanönü Deposit - Silica-Fe Gossan



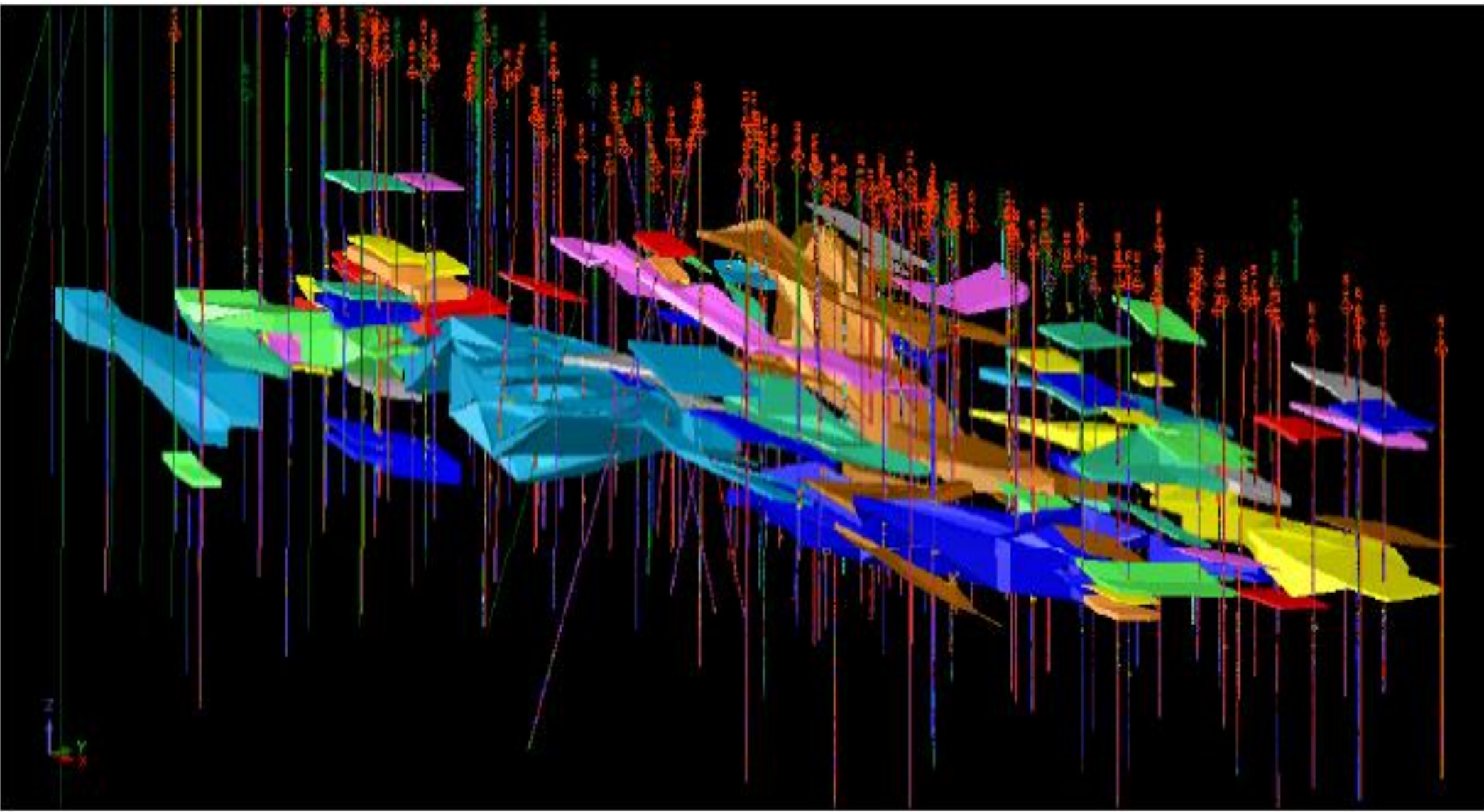


# Hanönü Deposit Resource drill sites on topographic base (2013)





# Hanönü Deposit Resource Model



3D view onto the mineralized bodies of copper project; 83 separate mineralized bodies have been modeled. DMT Presentation Oct 2013



# Gentor's Progress in Turkey 2011- 2012

- **October 2011 – Mar 2012 Establishment in Turkey**

*Initial Central Pontide field visit by Gentor staff –Bob Close and Andrew McCarthy  
Set up of local Turkish company & opened Ankara Office – headed by Country Manager Dr Omer Celenk*

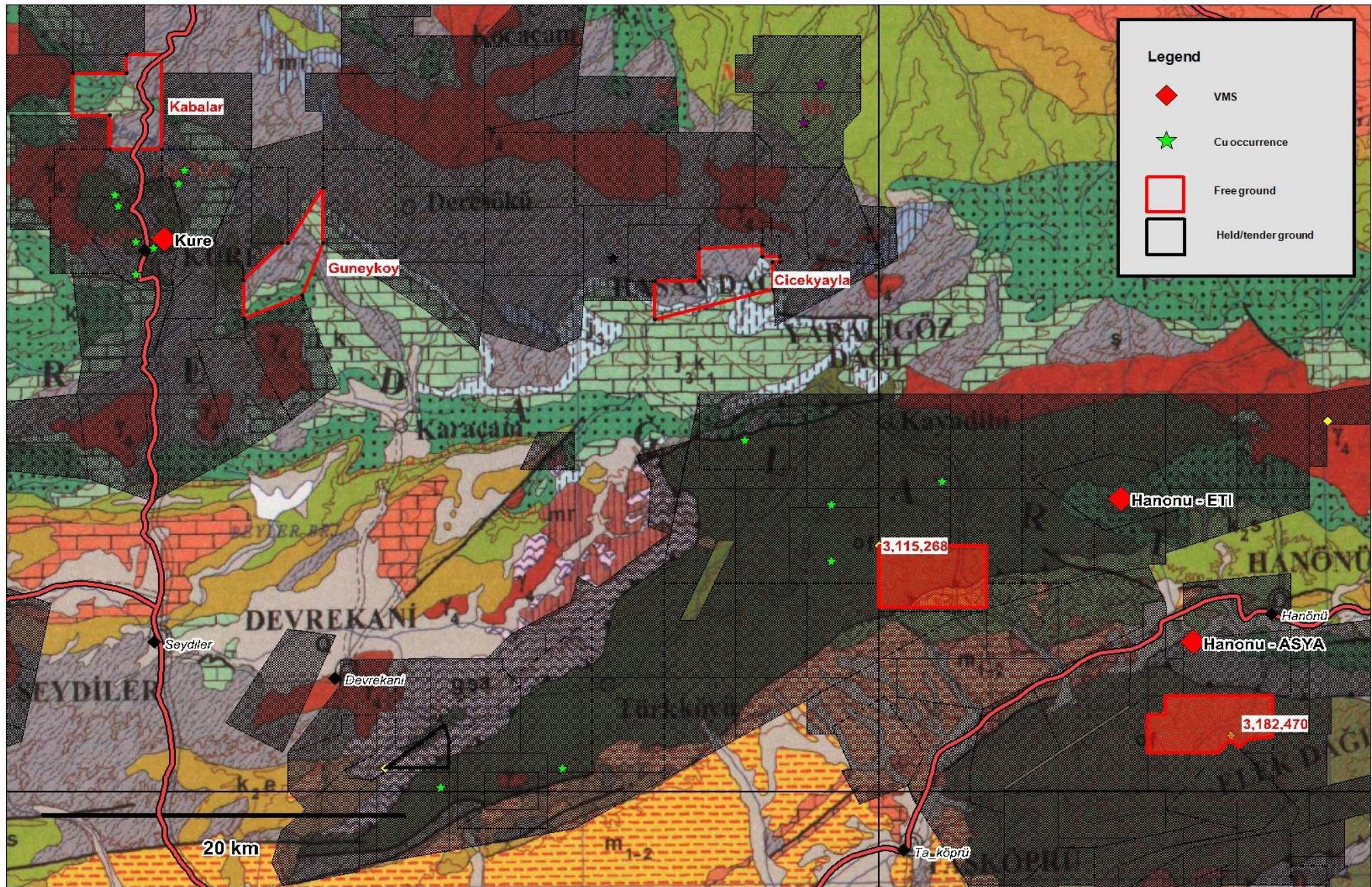
- . Purchased Regional Turkish Database – topography, geology & tenements*
- . Utilised Consultants (ex-MTA) for field and data input on Turkish VMS potential*
- . Selected 5 regions with potential for VMS discovery*
- . Initial focus on Central Pontides – Jurassic Ophiolite Sequence, mine visits confirm potential*
- . Gentor was offered 50% equity in the Hanonu deposit for \$5m but could not secure the required finance*
- . Reconnaissance geological mapping & geochemical sampling by Gentor personnel commenced in Kastamonu- Sinop region (March- June 2012)*

- **June-August 2012 – Karaburun VMS discovery**

- . Followed focus on volcanoclastic sequences between Hanonu and Boyabat in Domuzdag Melange*
- Resulted from field mapping of selected Tender ground in Hanonu district due for release on Dec 2012*
- . Tenders withdrawn by Government in Oct 2012, so Gentor negotiated an easy JV with adjacent tenement holder Dincer to secure the down dip and strike extensions of this large VMS system*

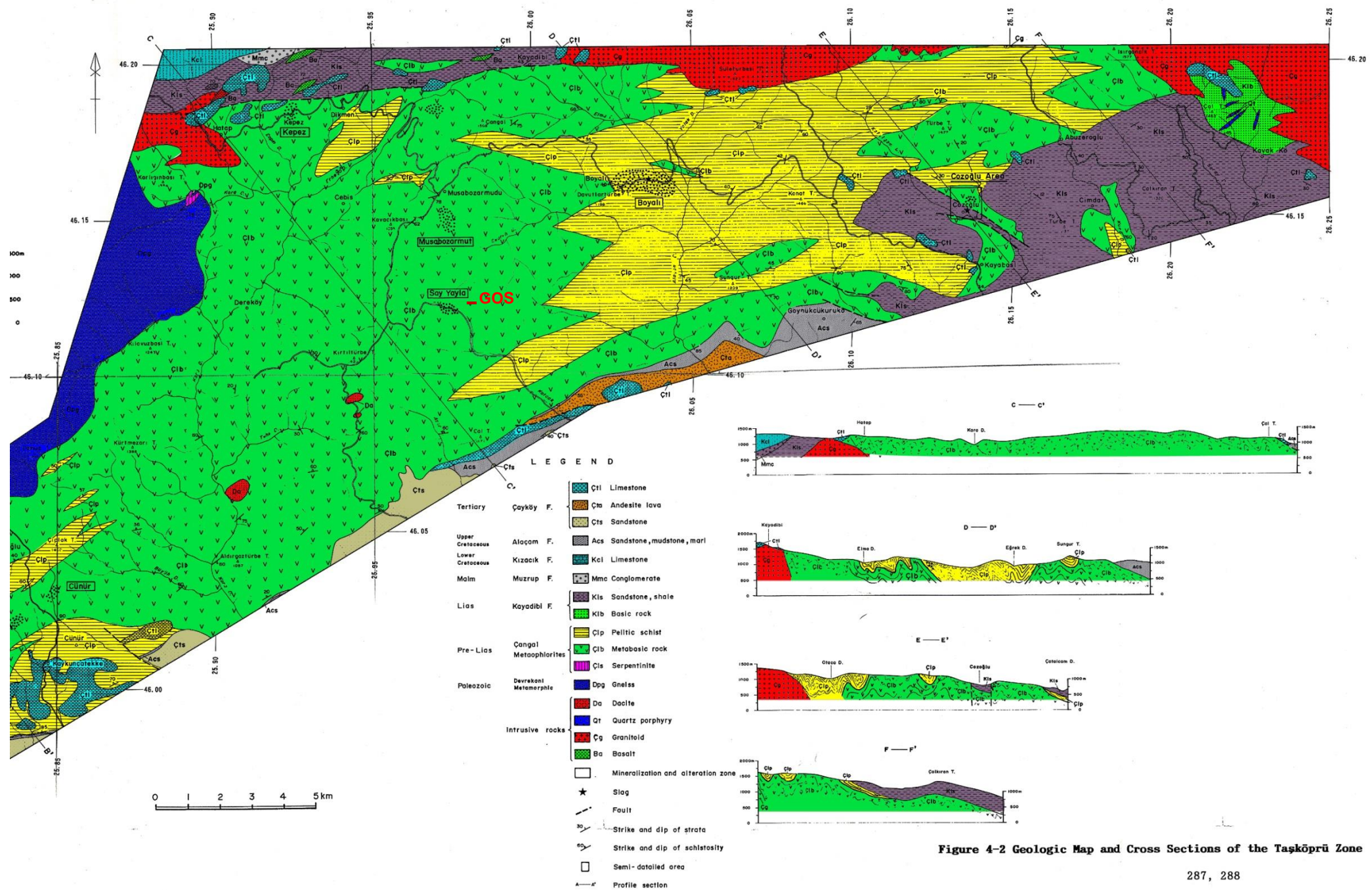


# Küre - Hanönü Region license targets- Early 2012



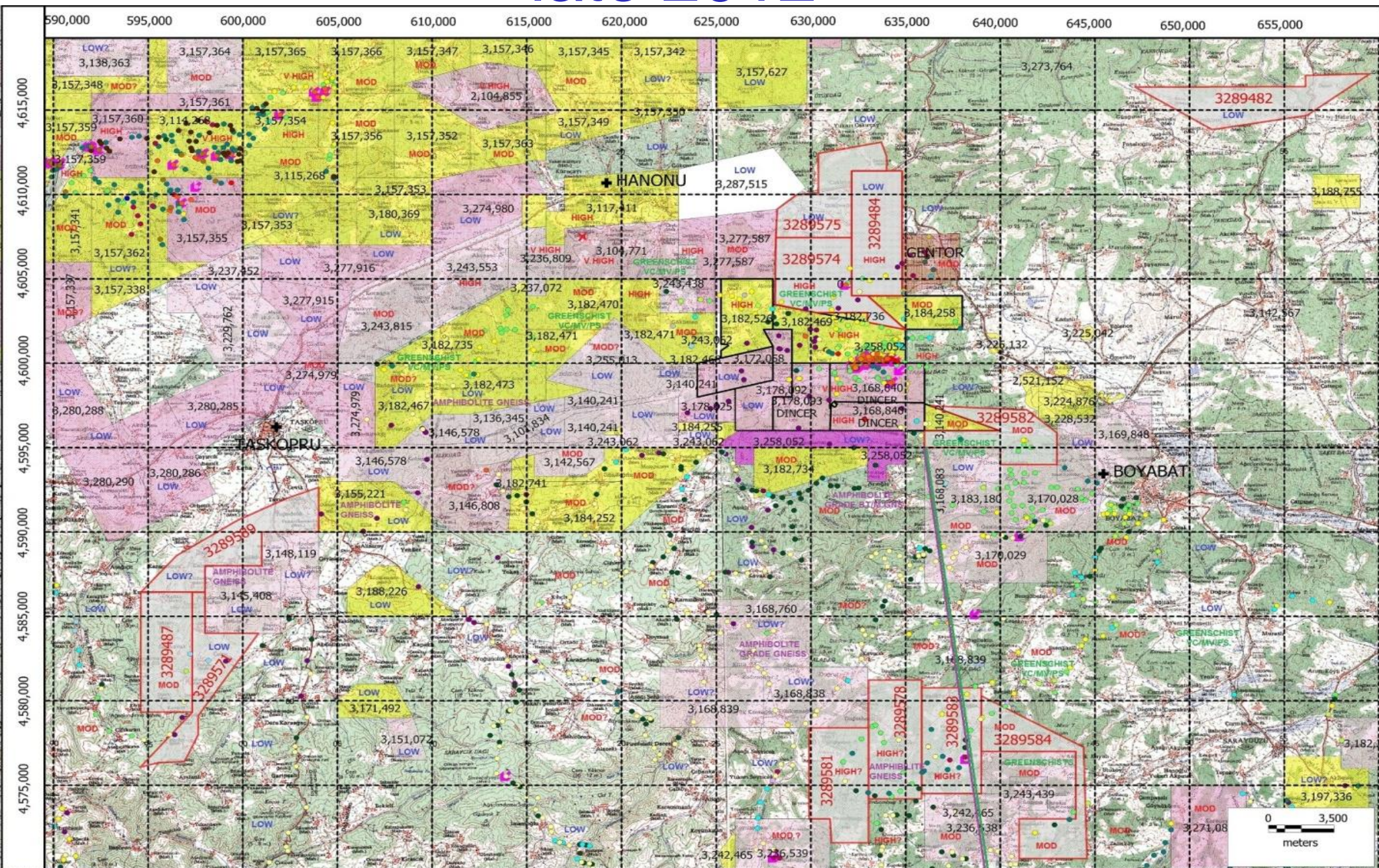


# JICA Çangaldag Volcanics Prospect Map



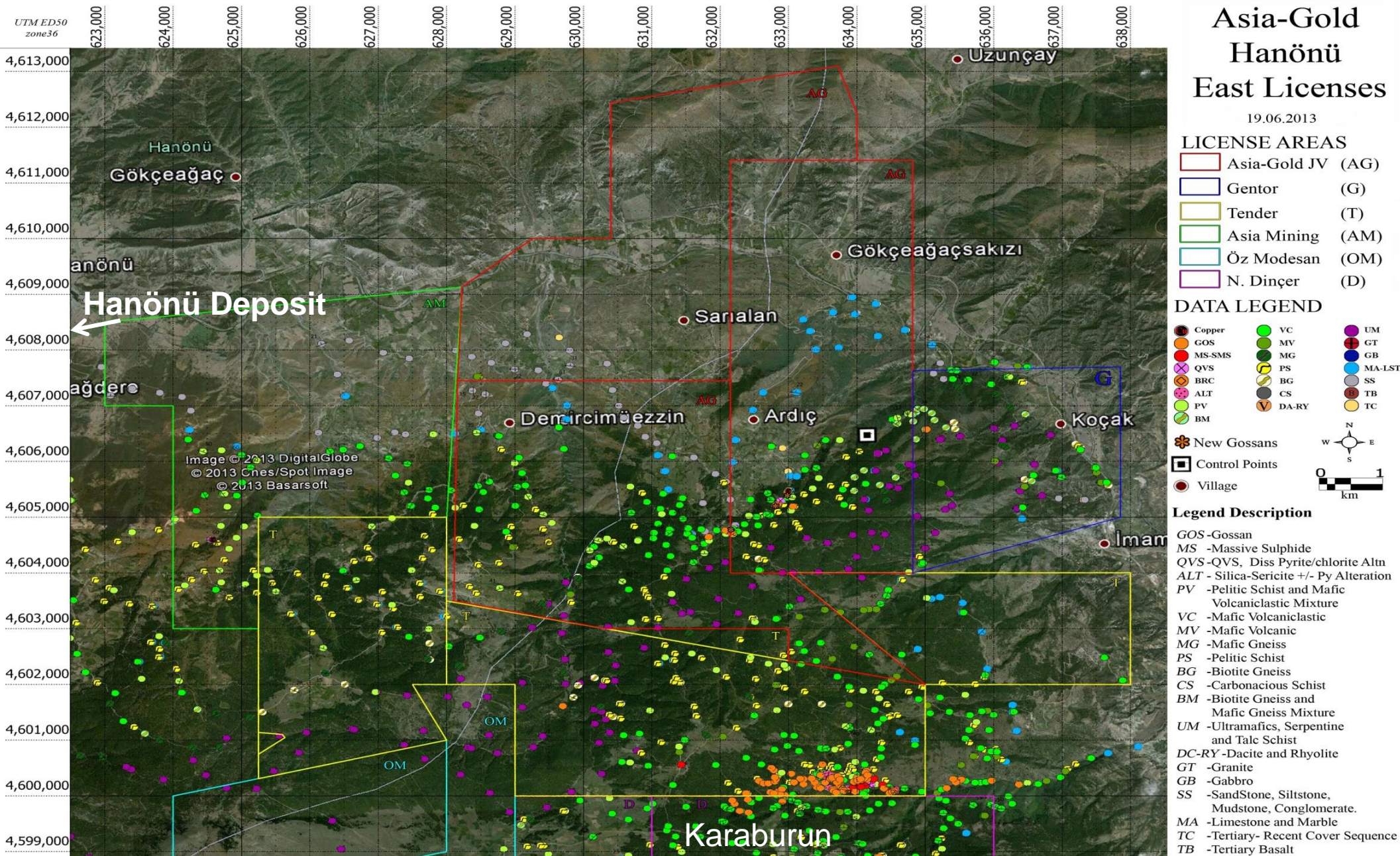


# Hanönü Region license targets - late 2012





# Hanönü – Karaburun District 2013 Geology Pts and license targets





# Hanönü- Boyabat Region 2013 Interpretive Geology

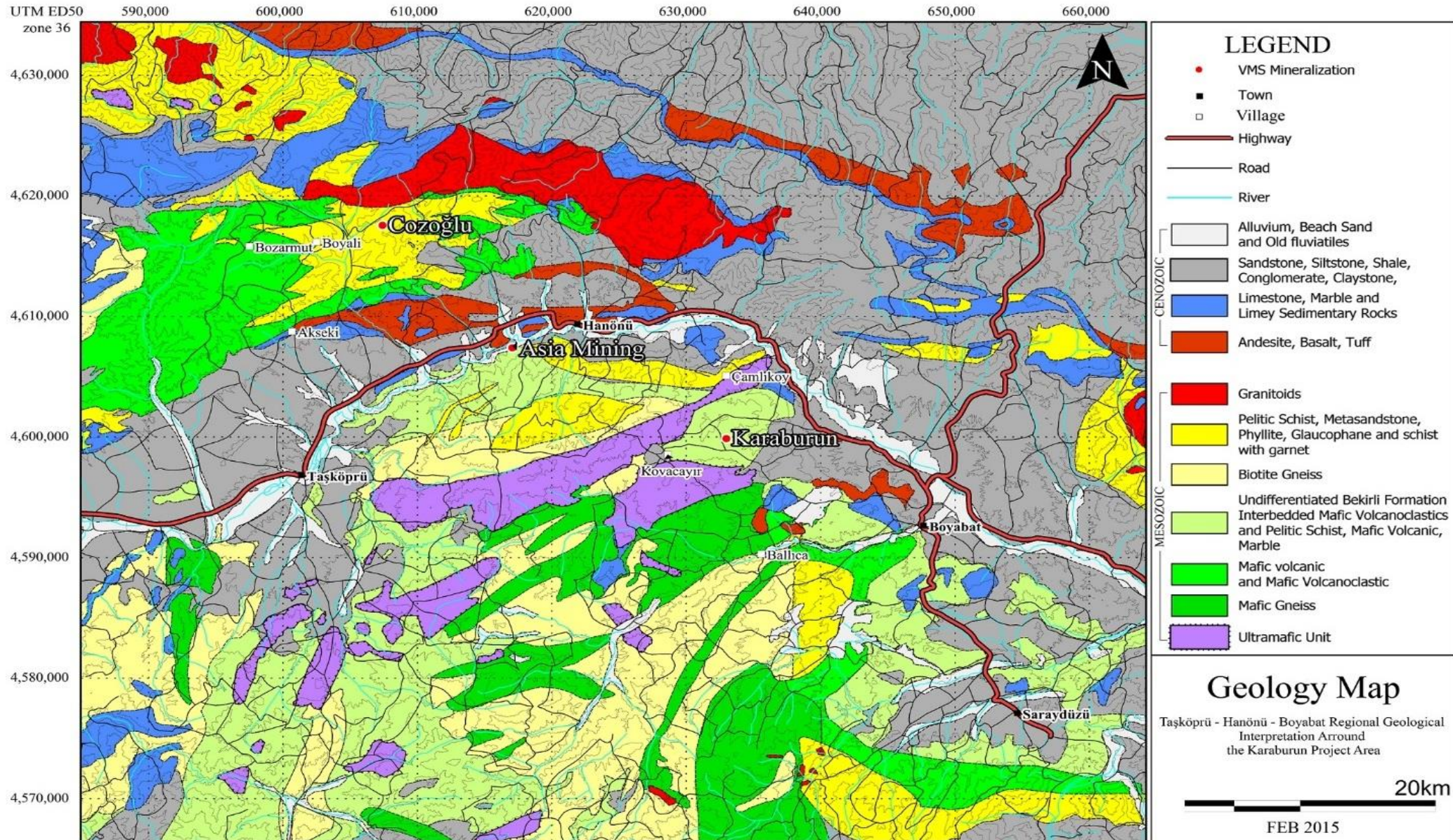
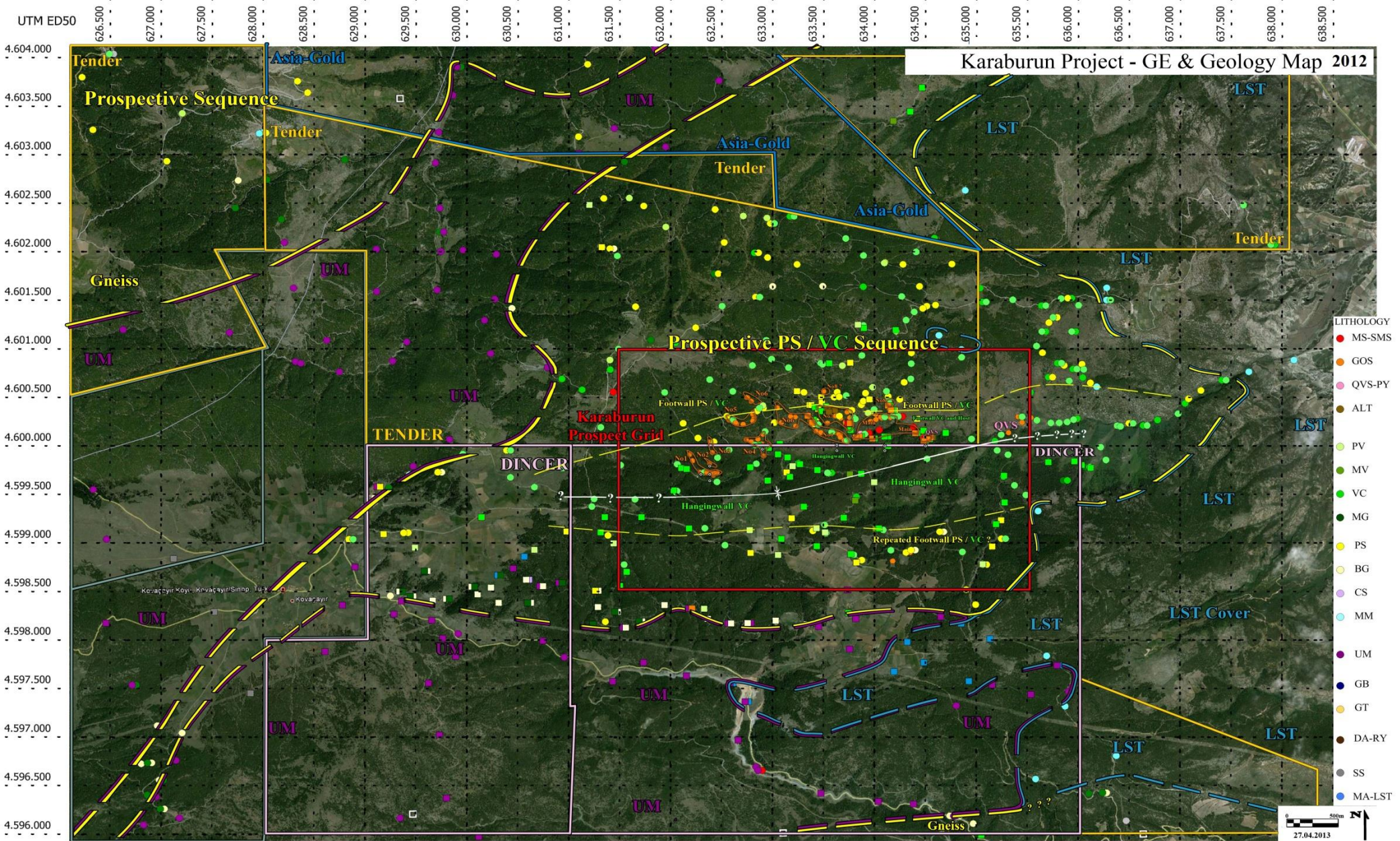


Figure - Major lithologies



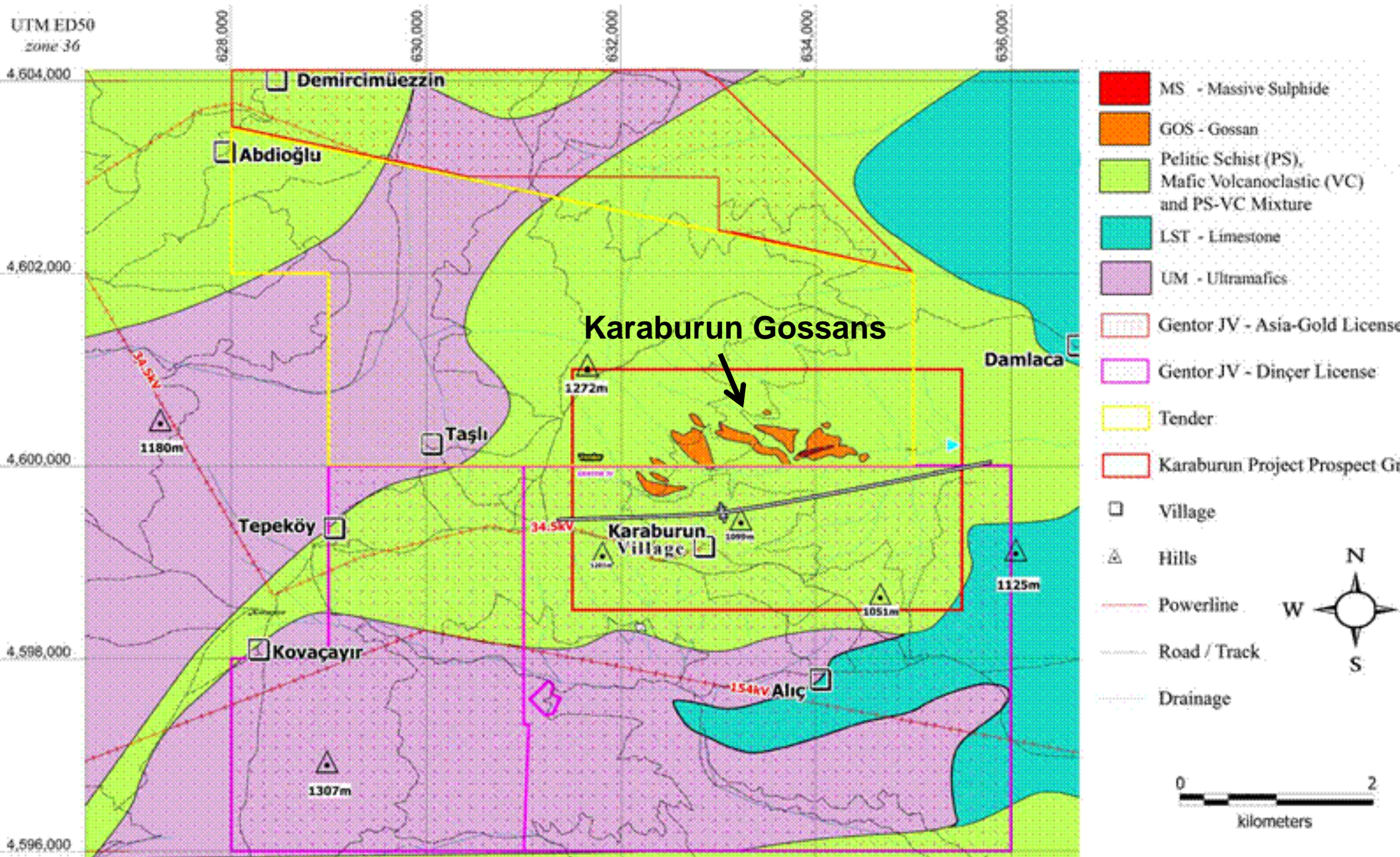
# Karaburun Project area 2012-13

## Prospective sequence and gossans





# Karaburun District – Summary Geology & Tenements 2012





# Gentor Progress in Turkey 2013-2014

- **April – Aug 2013 Regional Kastamonu evaluation**

Regional mapping conducted to assess the broader Kastamonu region for more copper deposits. **Priority target areas established in the Hanonu-Boyabat districts**

- **May 2013 – Asya Gold JV signed over Hanonu East area**

**Gained JV title to prospective Bekirli Formation sequence directly north of Karaburun and along strike east of the Hanonu deposit**

- Discovery of minor gossans at similar stratigraphic level to Karaburun

- **June 2013 - JV signed with Dincer over south Karaburun**

***Surveys commenced to better define the gossan system and host stratigraphy***

***Reconnaissance mapping and grid XRF soil/rock geochemistry defined the size and quality of this VMS system within the JV and to the north in prime tender ground***

*Grid surveys conducted over and around known copper mineralisation (June-Aug)*

*Planning for drilling assessment of main resource targets (July) with Stage 1 program -*

*Diamond drilling of 1200m in 12 holes targeting the shallow MS portion of four gossan zones*

*Permitting for drill site access in forestry delayed by Government*

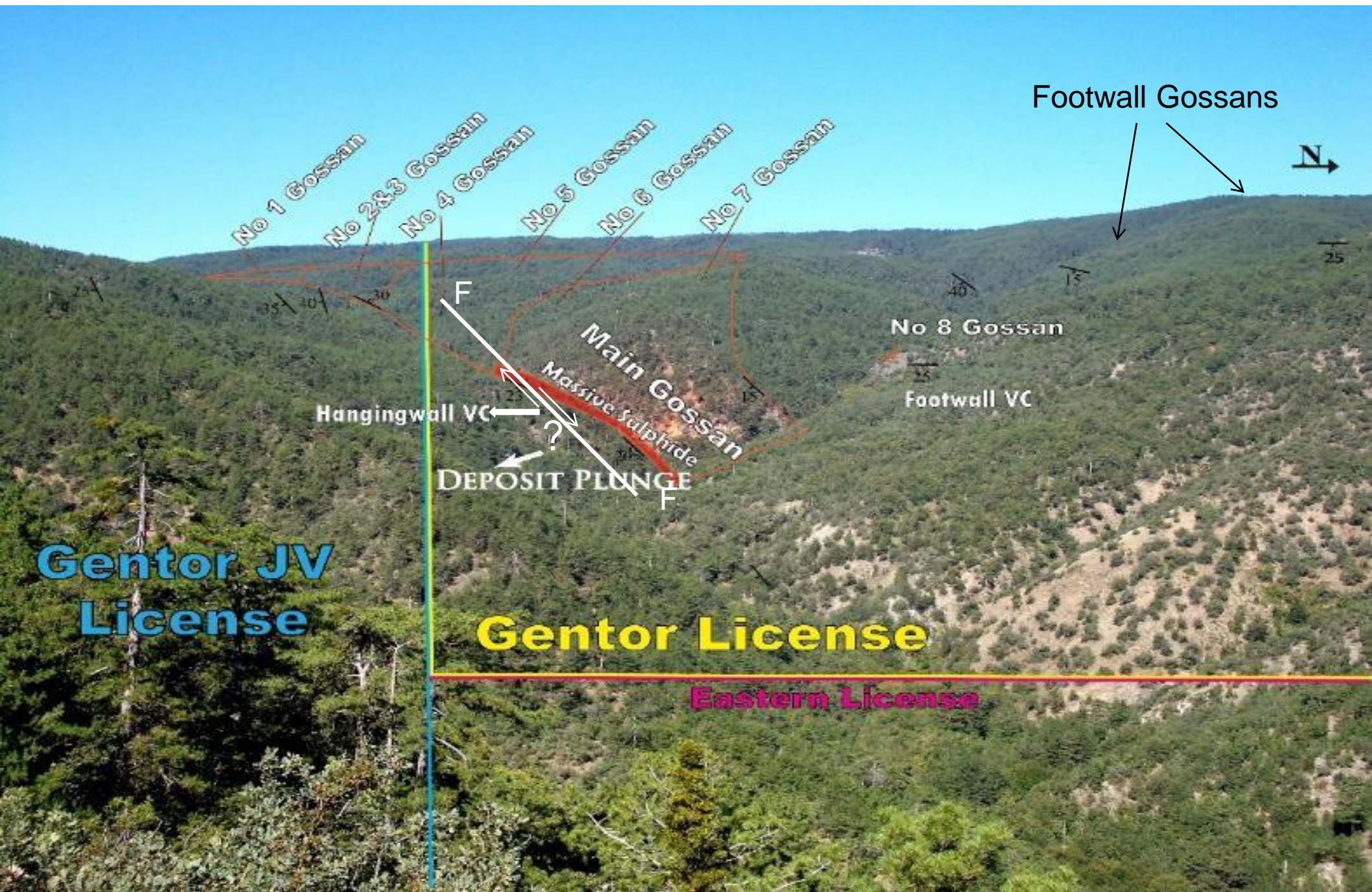


# Karaburun Project – initial view in forestry setting



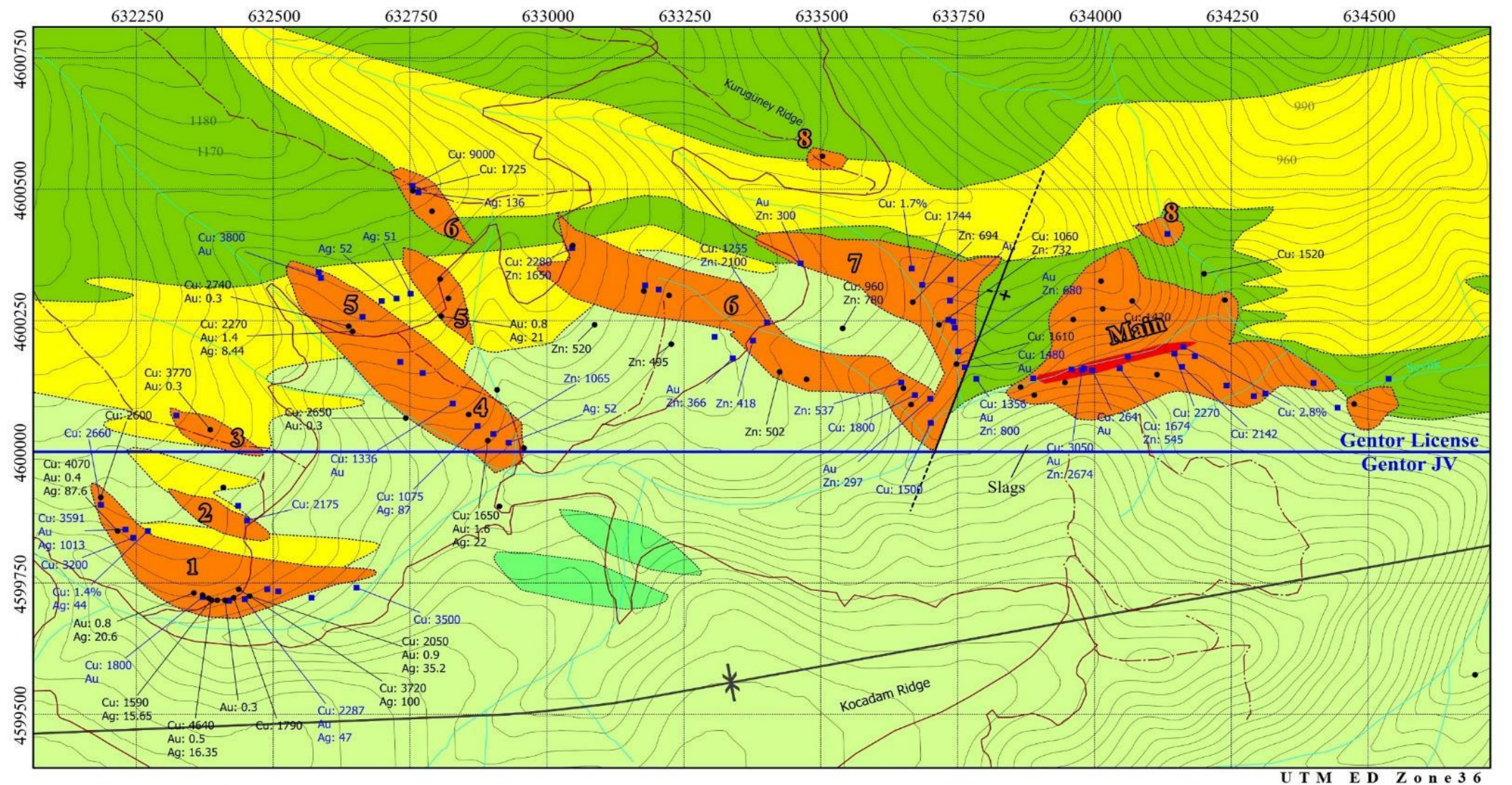


# Karaburun Project - Gossans & Licenses





# Karaburun Gossan Geochemistry

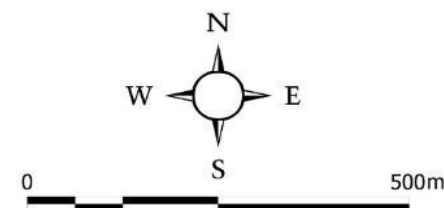
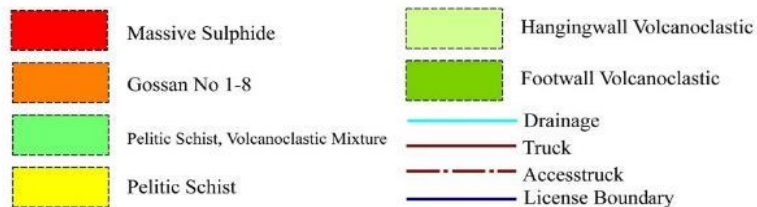


## 2013 Rock Geochemistry

● Sample Point - ALS Laboratory (ppm)

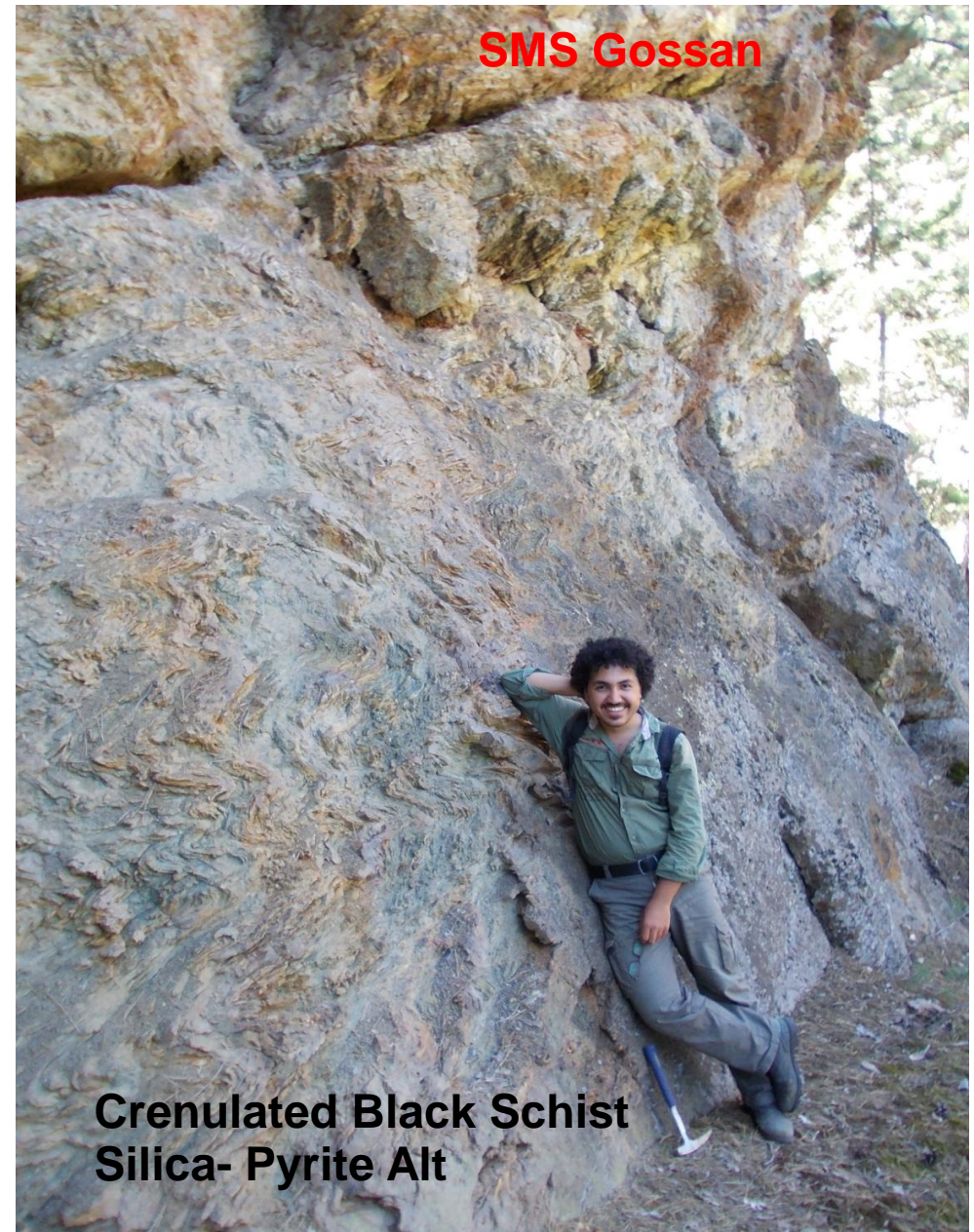
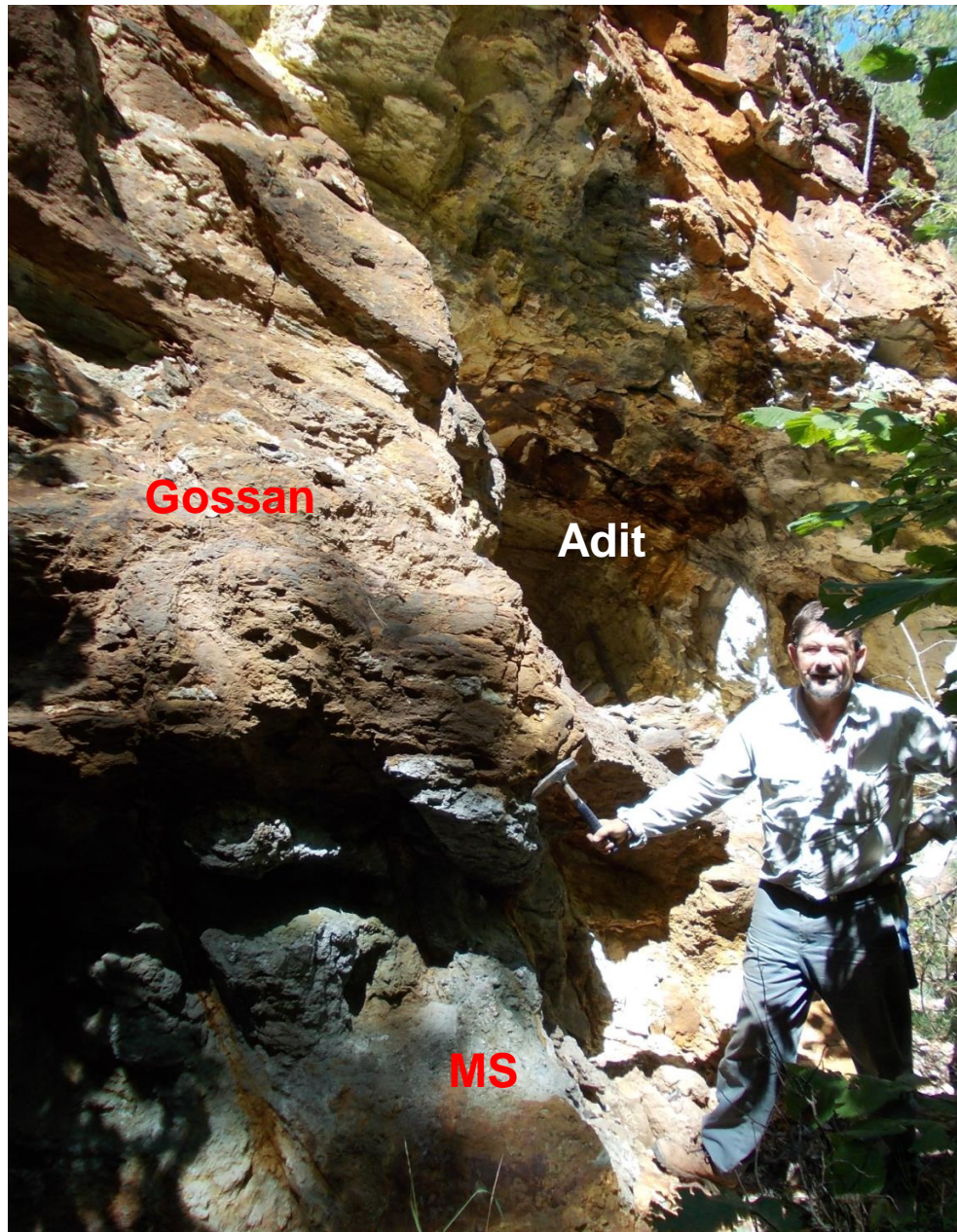
■ Sample Point - Portable XRF Insitu (ppm)

*XRF shows only presence of gold*





# Karaburun Main Zone MS & Pelitic Schist





# Karaburun Main Zone VMS in Adit

“showing secondary copper- chalcantite in folded MS”





# Karaburun Main Zone Gossan





# Karaburun No 5 Zone Gossan





# Karaburun No 1 Zone Gossan





# Karaburun Project - Discovery Summary

In August 2012 Gentor found a significant metasediment-hosted VMS gossan system in forest terrain at Karaburun about 20km SE of Hanonu during its regional reconnaissance mapping program. This project lies in Bekirli Formation greenschist facies schistose pelites and mafic volcanoclastics similar to the nearby Besshi style Hanonu deposit.

The stratabound gossans extend E-W along strike for 2.5km and are stacked over an estimated 400m thick shallow dipping mixed metasedimentary package with northern stockwork footwall zones.

Initial XRF rock and soil results defined coincident Cu-Zn-Au-Ag and local Co anomalism associated directly with the gossans with peak values of 0.5% Cu and 1.6g/t Au in the No 1 Zone at the inferred top of the sequence. Minor Cu workings within barren pyritic MS occur in the Main Zone, and drainage geochemistry defines the gossan package.

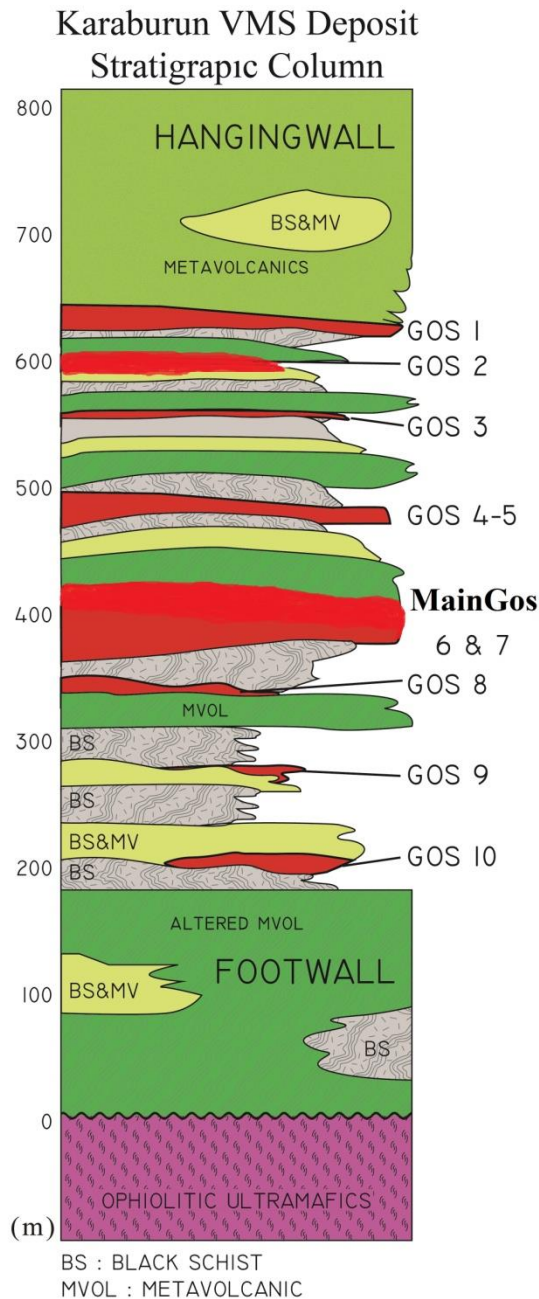
Given the impressive length, stacked nature and thickness of these gossans (the Main Zone in the east being about 75m in a cliff face with pyritic MS in creek exposures over 300m near its base), Gentor considered this project has major resource potential similar to Hanonu, but shallower with less environmental impact due to its more remote position.

Several JV Agreements were signed by Gentor in 2013 with local explorers holding licences adjacent to the project. In particular the Dincer JV over the western and southern dip extensions of the VMS system, were evaluated by grid mapping and soil surveys which led to stage 1 diamond drilling following permitting in 2015. Gentor won a Government tender area covering the bulk of the gossan outcrop in 2014.



# Karaburun Project

## Stratigraphy & Exploration criteria



### **Besshi-Type VMS Cu Target**

*Distal volcanic-sedimentary environment*

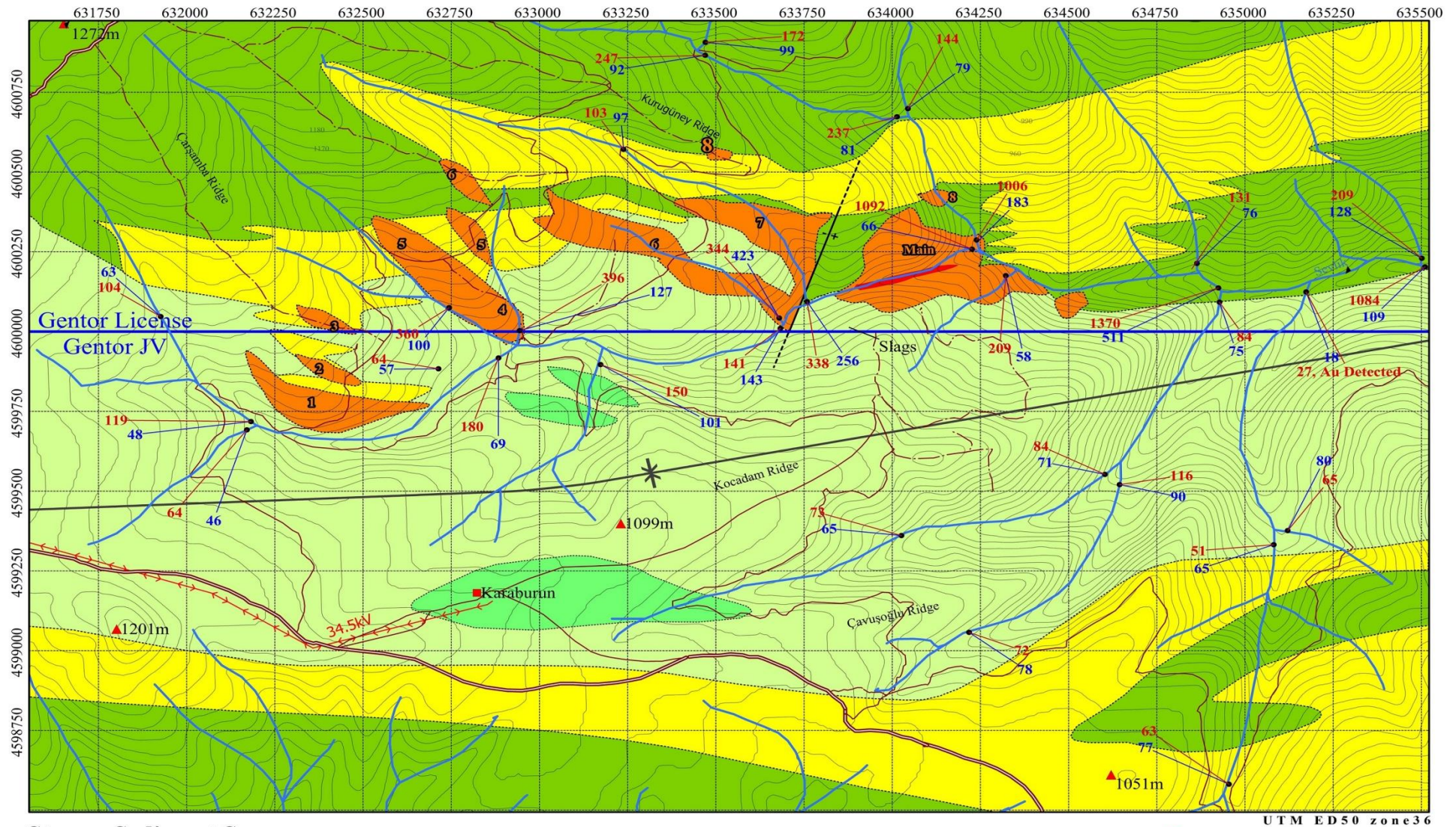
*Triassic-Jurassic volcanic-arcs & ophiolite melanges*

*Prime stratigraphy - Bekirli Formation greenschist facies & amphibolitic equivalent Domuzdag Formation*

- **Geology** – mixed schistose carbonaceous metapelites with bedded volcanoclastics, minor mafic volcanics ; overlying thrust ultramafics. Possible structural stacking of mineralised zones.
- **Geochemistry** – anomalous Cu, Au, Zn, Ag, Co, Fe, Mn
- **Alteration** – silica-pyrite-sericite in deformed pelites + chlorite-epidote in the host and footwall volcanoclastics
- **Geophysics**- No data but likely chargeable footwall stringer zones & SMS with conductive stacked MS zones
- **Access** – Reasonable forestry tracks in steep terrain



# Karaburun - Initial Summary Geology and Cu-Zn stream geochemistry 2013

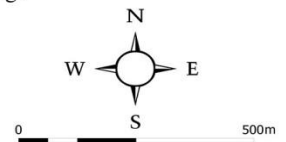


## Stream Sediment Survey (Using Portable XRF)

**Cu** — **Zn** — ● Sample Point  
(ppm)

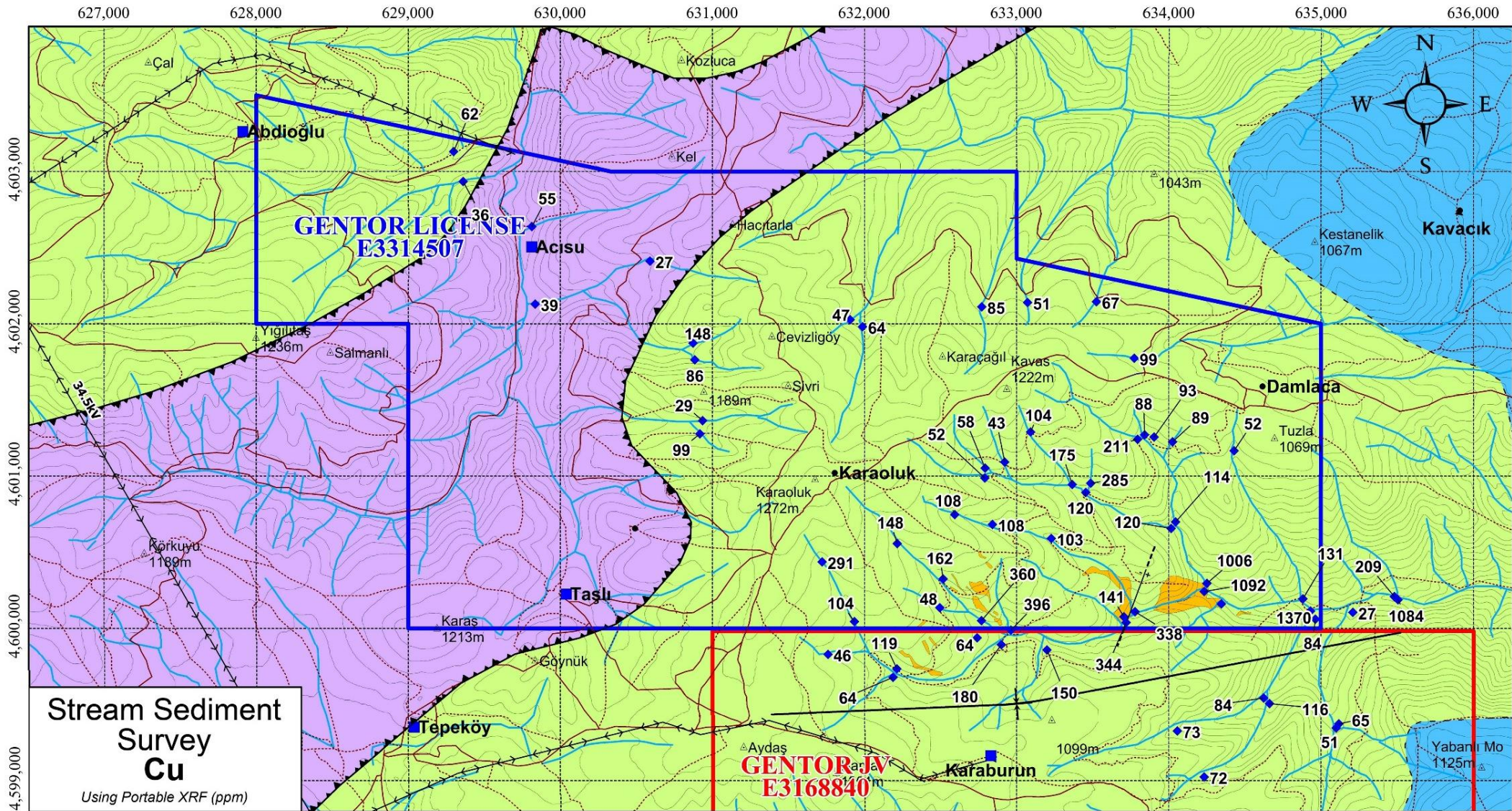
- |  |   |
|--|---|
| <span style="display: inline-block; width: 20px; height: 10px; background-color: red; border: 1px solid black;"></span> Massive Sulphide                               | <span style="display: inline-block; width: 20px; height: 10px; background-color: yellow; border: 1px solid black;"></span> Pelitic Schist                 |
| <span style="display: inline-block; width: 20px; height: 10px; background-color: orange; border: 1px solid black;"></span> Gossan No 1-8                               | <span style="display: inline-block; width: 20px; height: 10px; background-color: lightgreen; border: 1px solid black;"></span> Hangingwall Volcanoclastic |
| <span style="display: inline-block; width: 20px; height: 10px; background-color: lightgreen; border: 1px dashed black;"></span> Pelitic Schist, Volcanoclastic Mixture | <span style="display: inline-block; width: 20px; height: 10px; background-color: darkgreen; border: 1px solid black;"></span> Footwall Volcanoclastic     |

- |  |  |
|--|--|
| <span style="color: blue;">—</span> Drainage         | <span style="color: red;">■</span> Village |
| <span style="color: brown;">—</span> Road            | <span style="color: red;">▲</span> Hill    |
| <span style="color: brown;">—</span> Truck           |  |
| <span style="color: brown;">- - -</span> Accesstruck |  |
| <span style="color: red;">- - -</span> Powerline     |  |
| <span style="color: blue;">—</span> License Boundary |  |

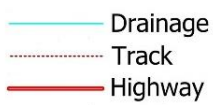




# Karaburun Project – Cu drainage survey, Gossans & Licenses. 2014



◆ Sample Point



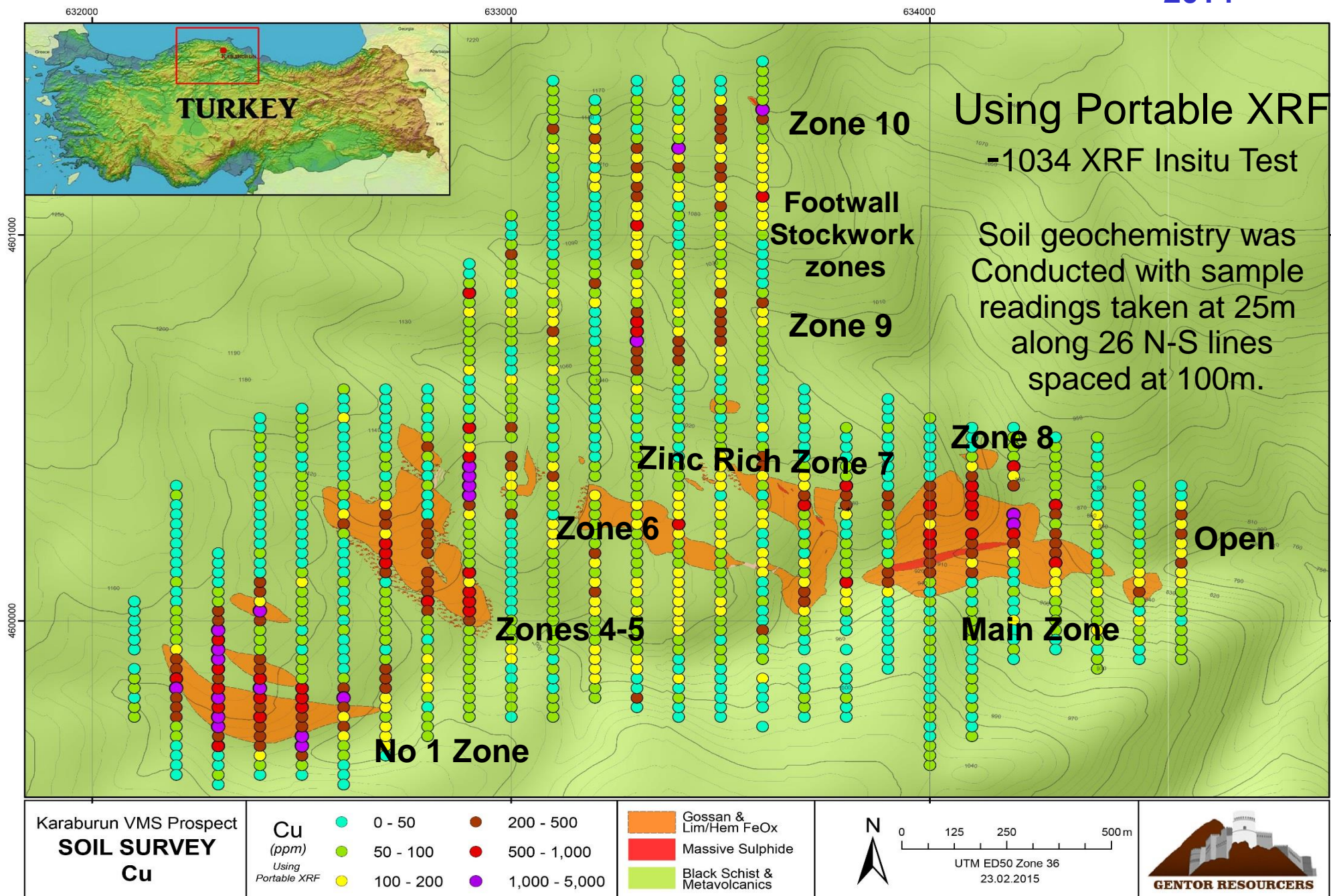
■ Village  
▲ Hill & Mountain  
• Plateau





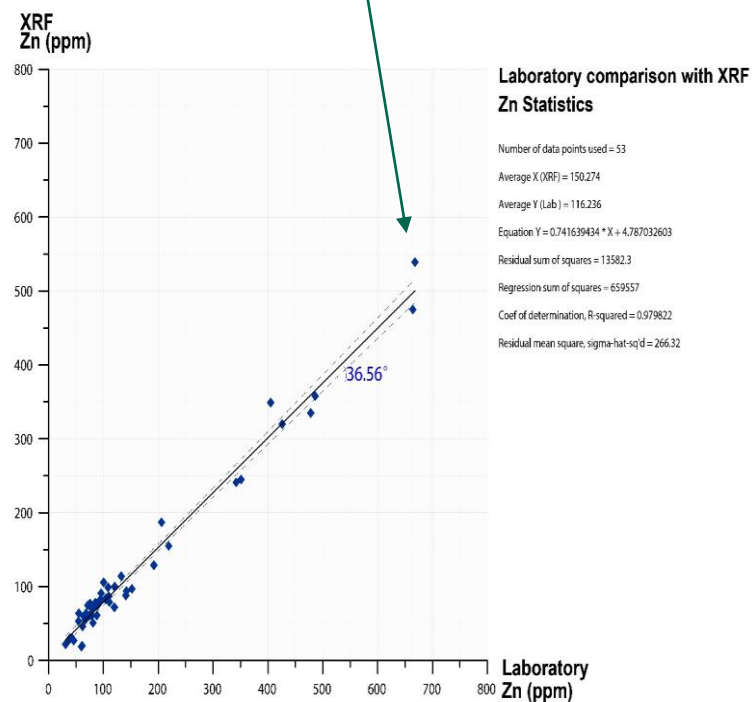
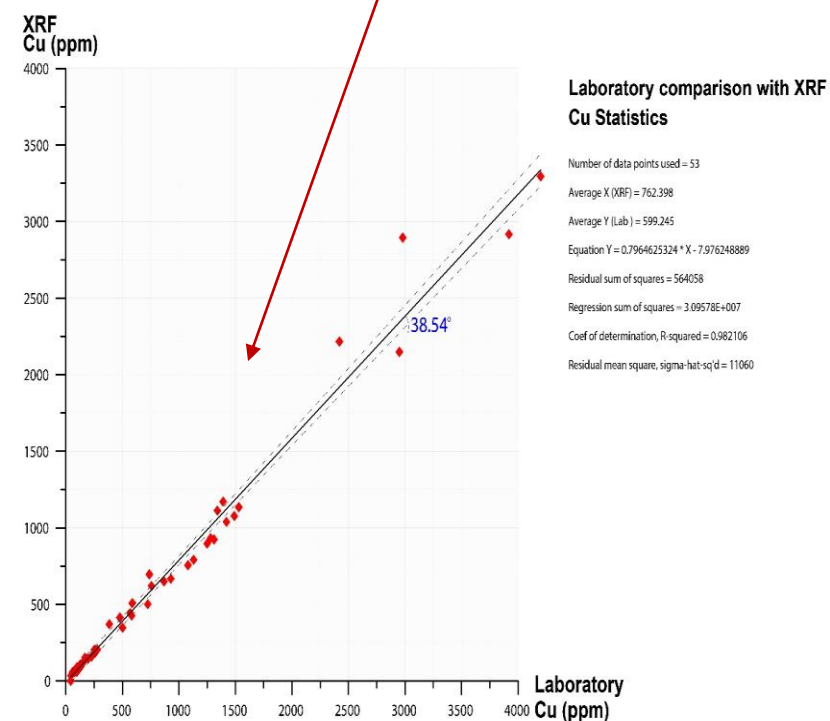
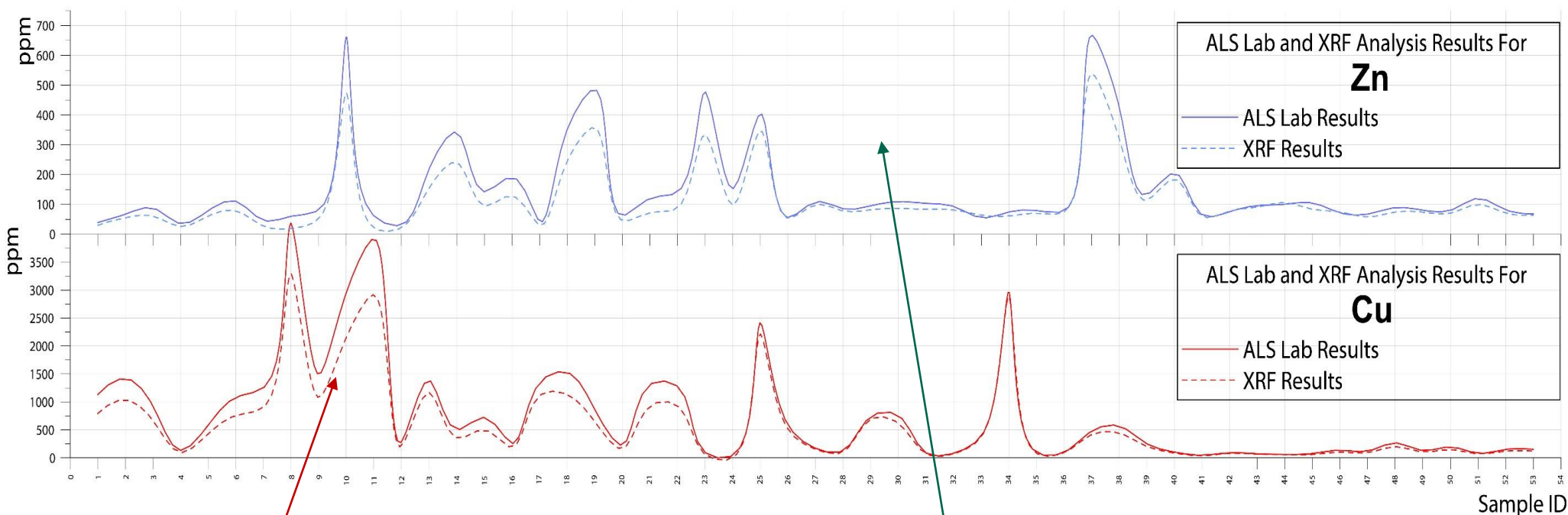
# Karaburun Project Cu soil geochemistry

2014





# Karaburun Project comparative soil analysis



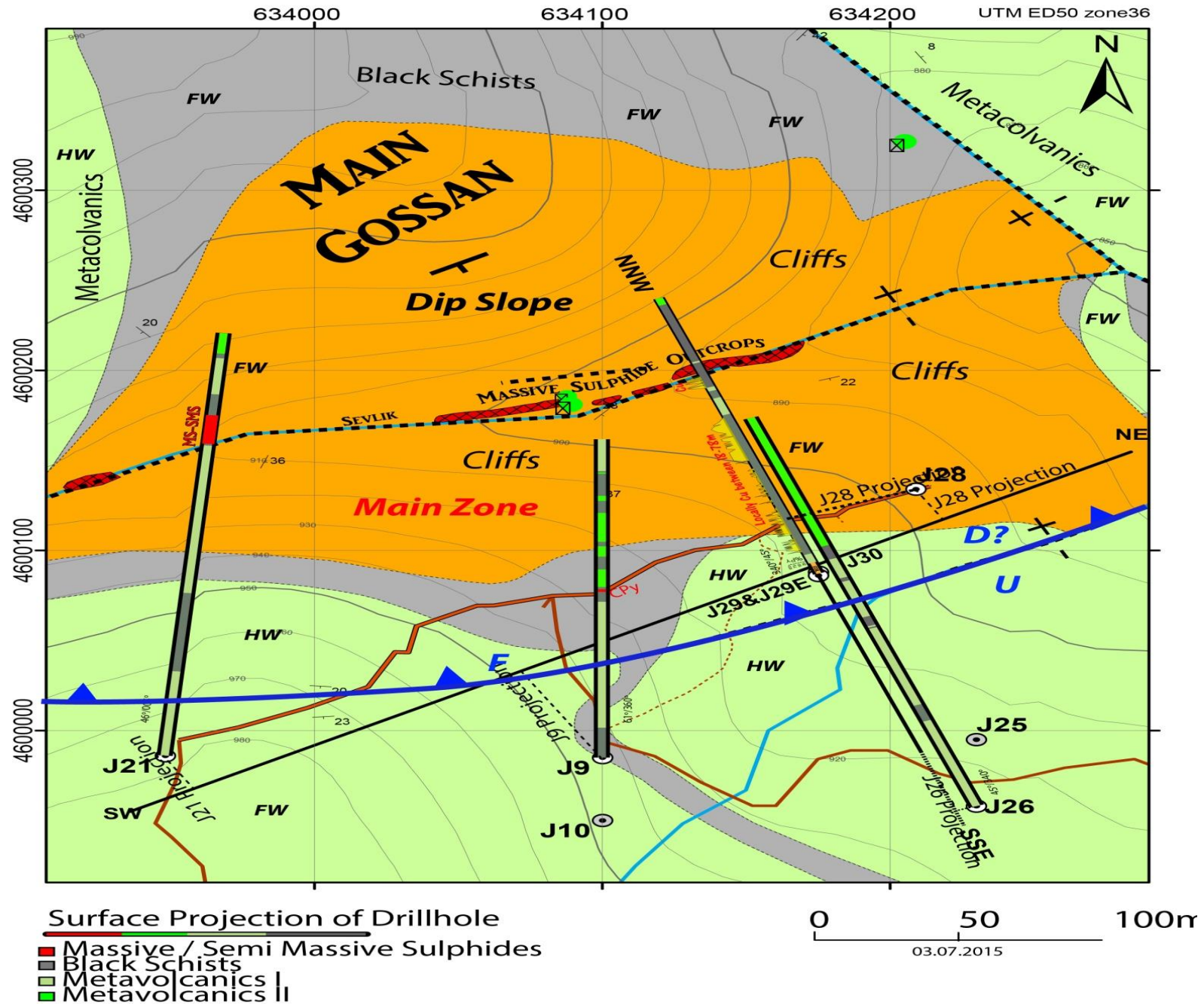
**Soil Results**  
**Cu & Zn**  
*XRF comparison with ALS Laboratory*



for more information  
<http://www.gentorresources.com/>  
 yildizee@gmail.com

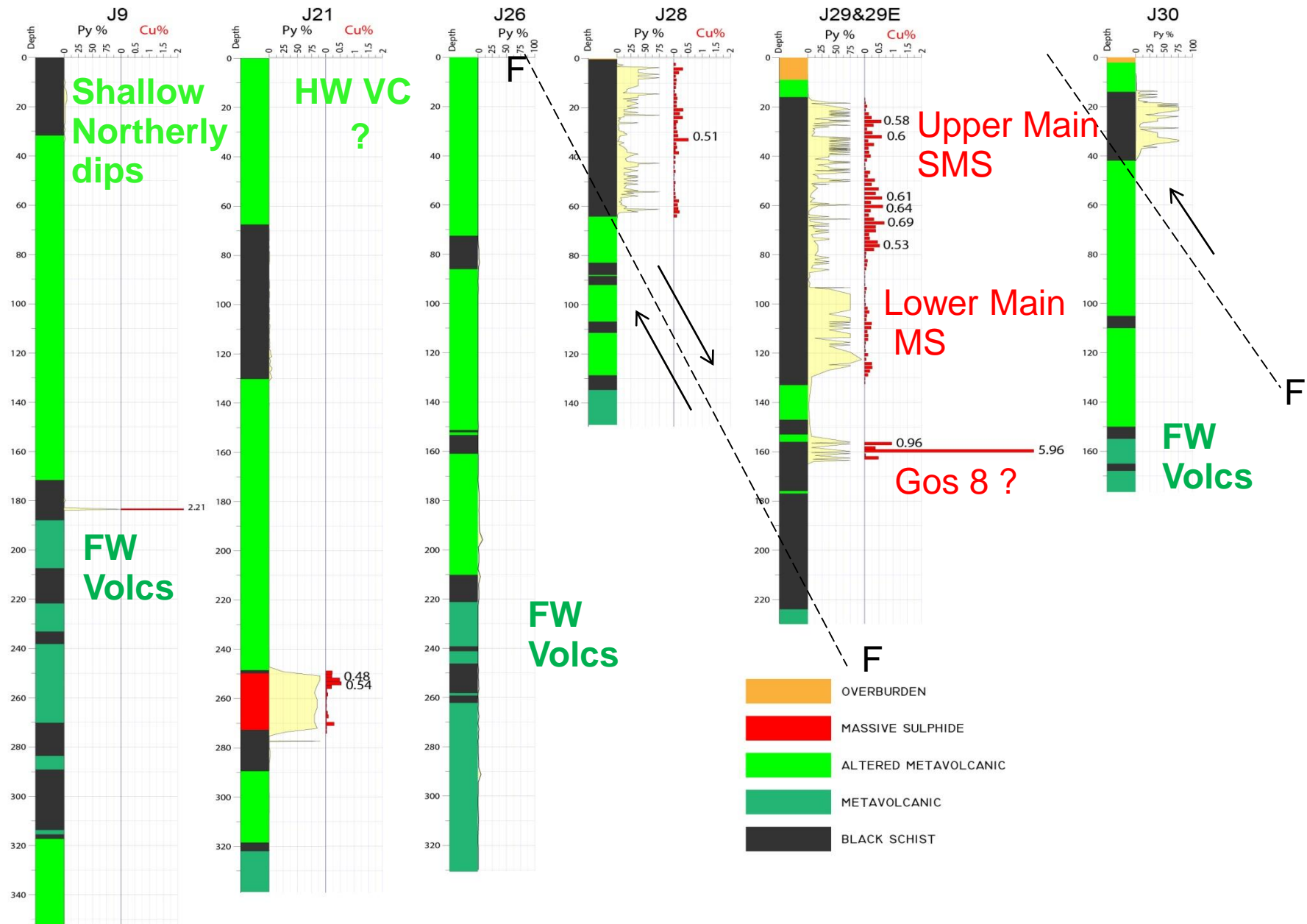


# Karaburun Main Zone Drill Plan



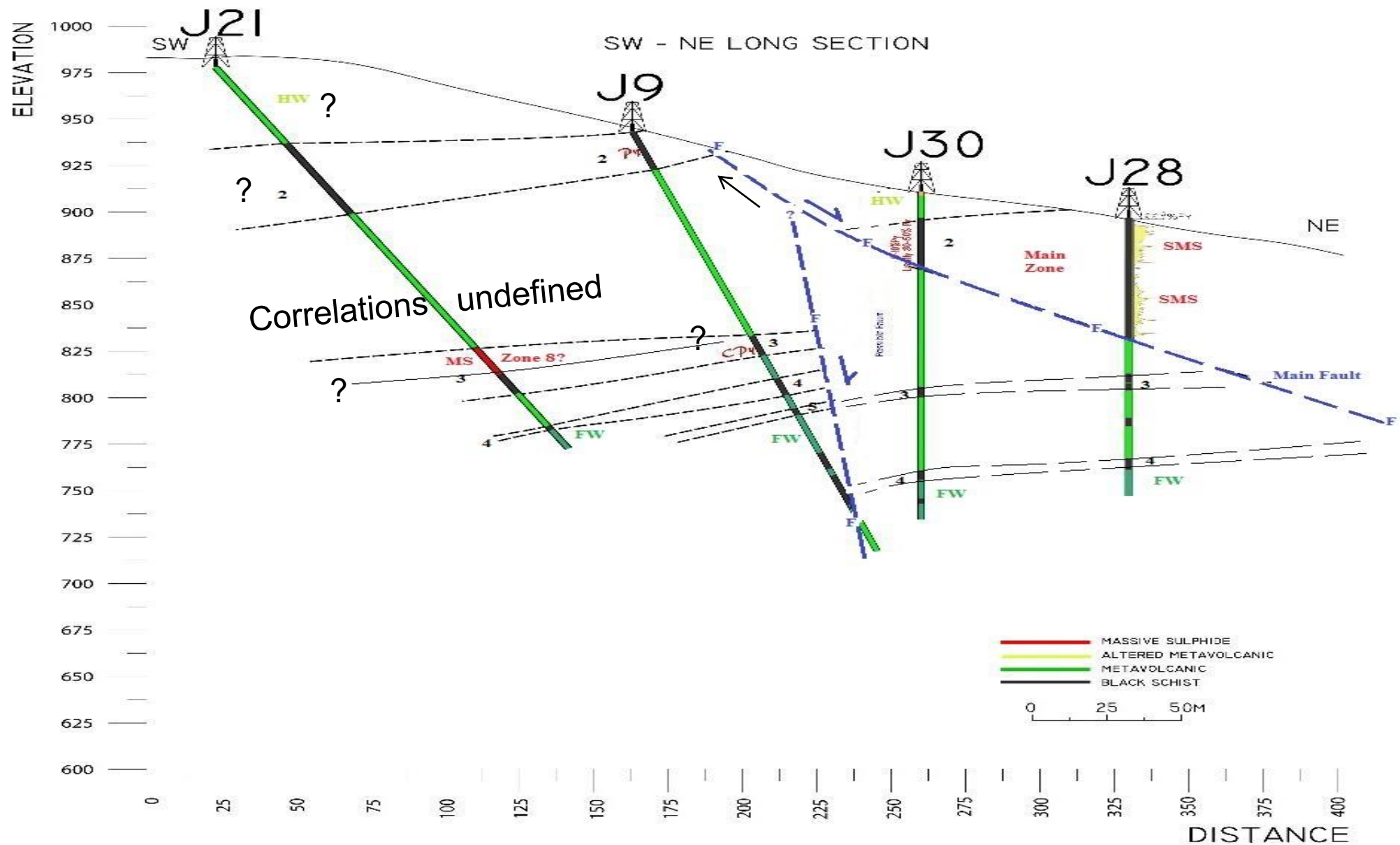


# Karaburun Main Zone Drill Summary





# Karaburun Main Gossan Oblique Drill Section

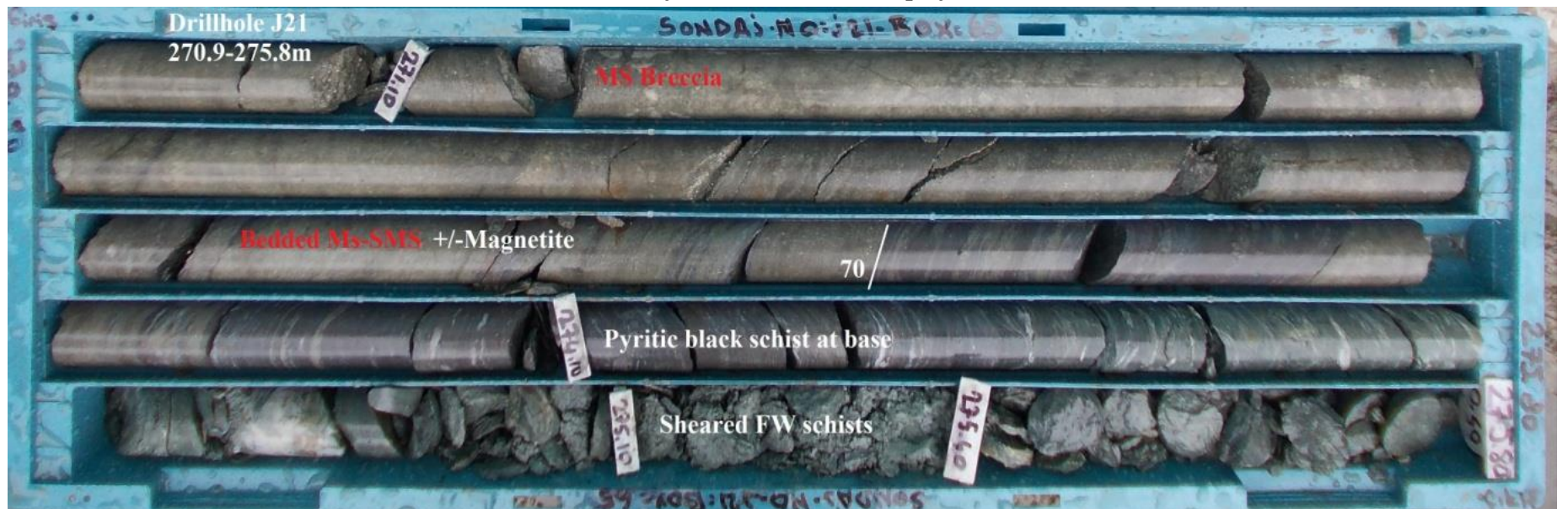




# Karaburun Project – Mineralised Drillcore



*Drillhole J21 core from 247.7-252.6m top of MS*



*Drillhole J21 core from 270.9-275.8m base of MS*



# Conclusions

- Turkey is a superior destination for VMS exploration due to its multiple well exposed Mesozoic-Tertiary Tethyan Ophiolitic and Island arc settings.
- Gentor Resource's small experienced VMS team selected the Central Pontides as the prime target area in late 2011 because it contained two recently discovered large (+25Mt) copper deposits and was relatively underexplored.
- The main target was Besshi-type deposits i.e. the 30Mt Hanönü deposit within Jurassic distal mafic volcanoclastics and terrigenous black schists melanges.
- Within 6 months regional reconnaissance road/track mapping and gossan search of prospective sequences utilising portable XRF technology, led to the 2.5Km long Karaburun VMS deposit discovery 20km south of Hanönü.
- Mapping and grid soil/rock geochemistry defined the stacked stratabound nature and strong Cu-Au geochemical zonation of this Besshi type gossan/MS system.
- Title acquisition through tender and JV licenses with local miners took two years to complete, then subsequent permissions delayed drilling until May 2015.
- Drilling of the 75m thick Main Gossan provided mostly low grade SMS intersections so further drilling and geophysical surveys are required to test the more anomalous zones higher in the system to define economic resources.
- Recent exploration by other groups has defined several new Cu prospects, thus confirming Gentor's original strategy of this regions VMS resource potential.