Conference on
Exploration and Exploitation
of Critical Raw Materials

Comparative Study of Phosphorite Deposits in the Tethyan Phosphogenic Province: Active Exploitation in Türkiye and Abandonment in Albania

by **Ana Fociro**, Hüseyin Öztürk, Agim Sinojmeri, Zeynep Cansu, Lavdie Moisiu

7-8 October 2024, Tallin, Estonia

EGT-TWINN

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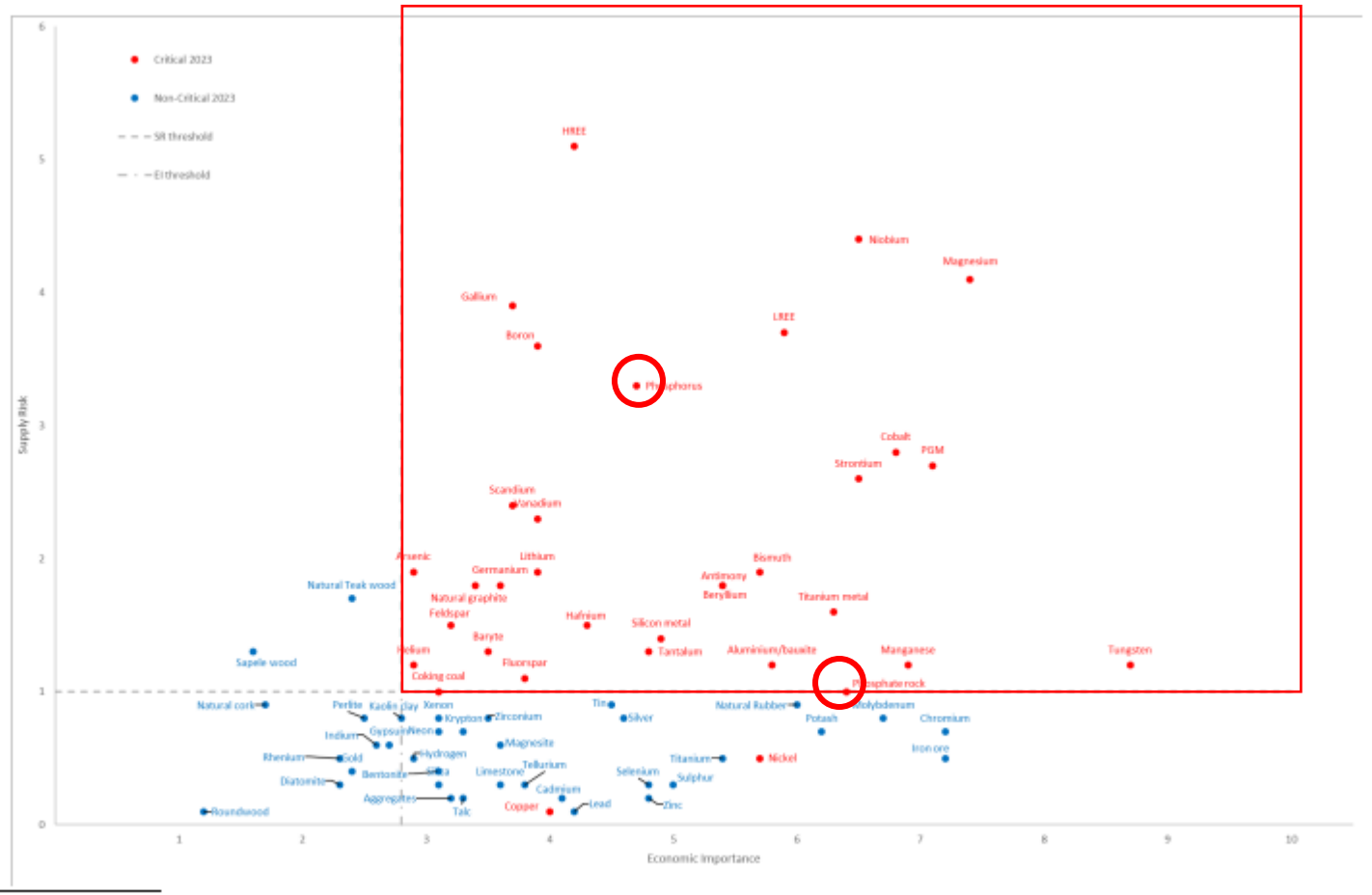
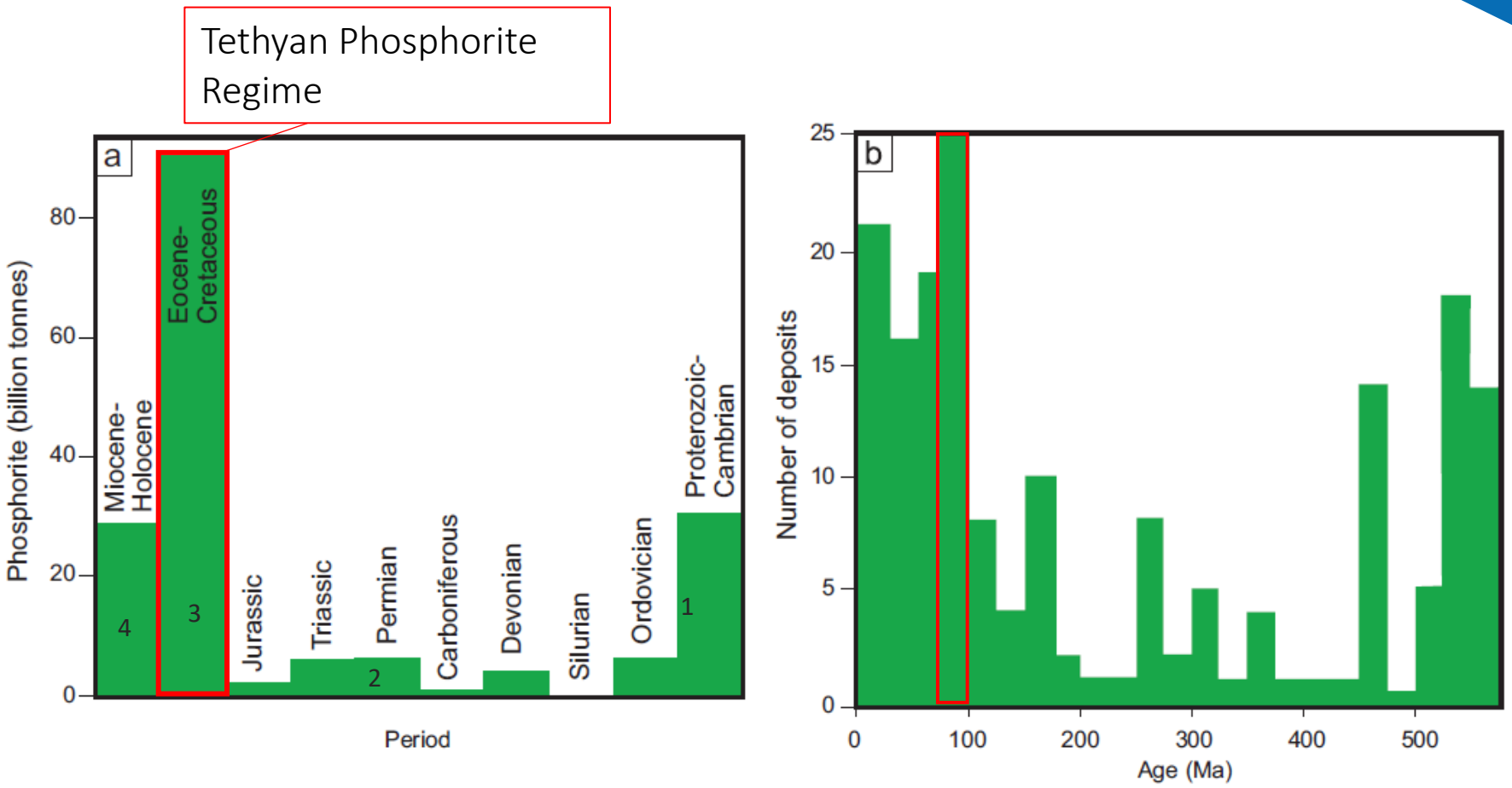
Why phosphate rocks?

Results of the 2023 EU criticality assessment

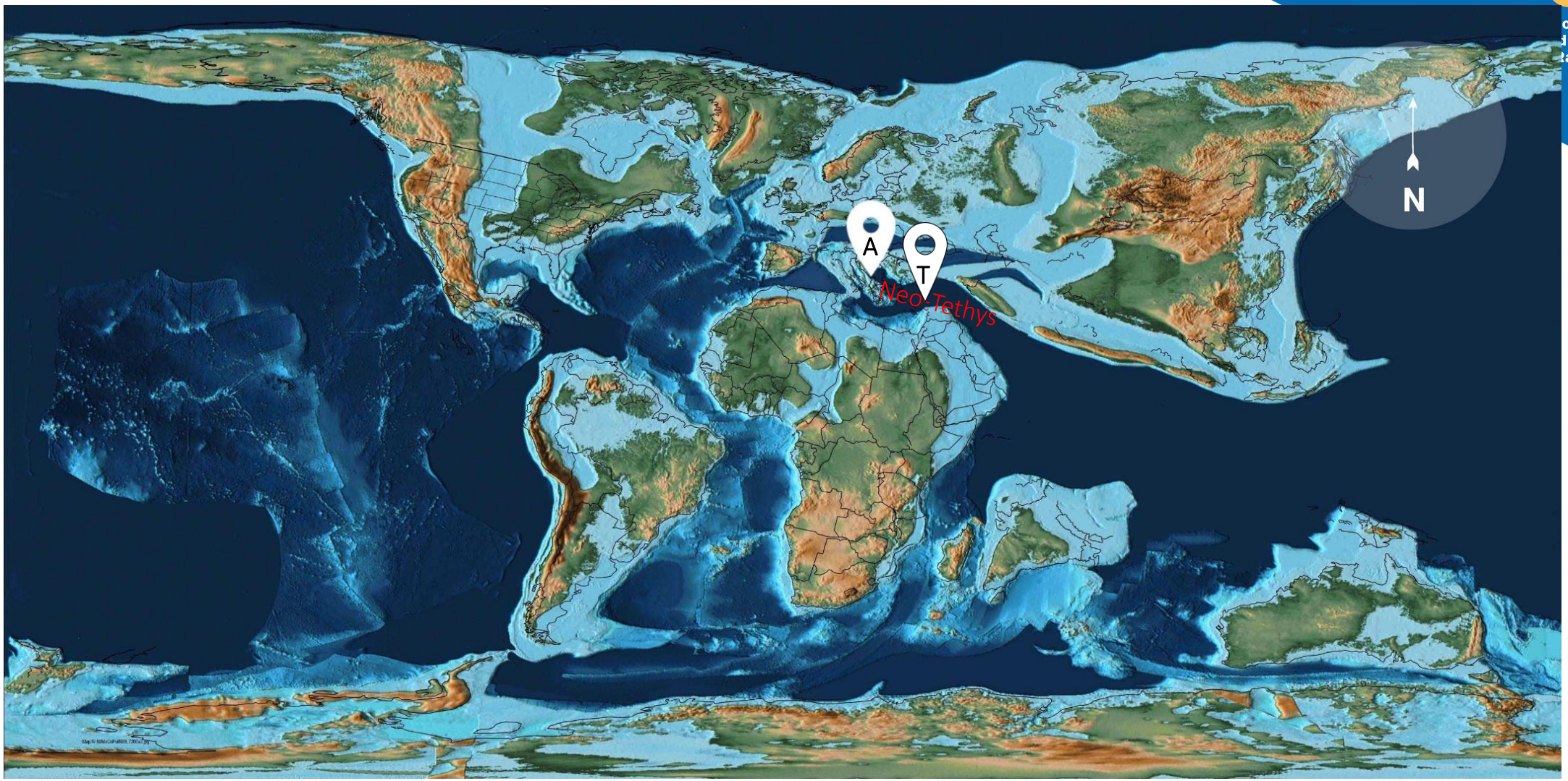


[5] Copper and nickel do not meet the CRM thresholds, but are on the CRM list as Strategic Raw Materials.



Phosphorite deposition periods. a) Timely deposit; b) Number of economically important sites (Modified according to Notholt et al., 1980; Sheldon, 1980).

Location of the main phosphate deposits in the Mediterranean Phosphogenic province (Bardet et al., 2017). Highlighted in red the Albanian deposits area.



Paleogeographic map during the Upper Cretaceous, showing Albania (A), Turkey (T) and Neo-Tethys.

Current situation in exploration and exploitation

Albania, stopped in the ‘90

Used about 60,000 tons of reserve over 20% P_2O_5 and From the estimation carried out in 12 studied deposits, a quantity of 57 million tons of geological reserves are calculated and with a perspective for their further enlargement.

Source, NANR Albania

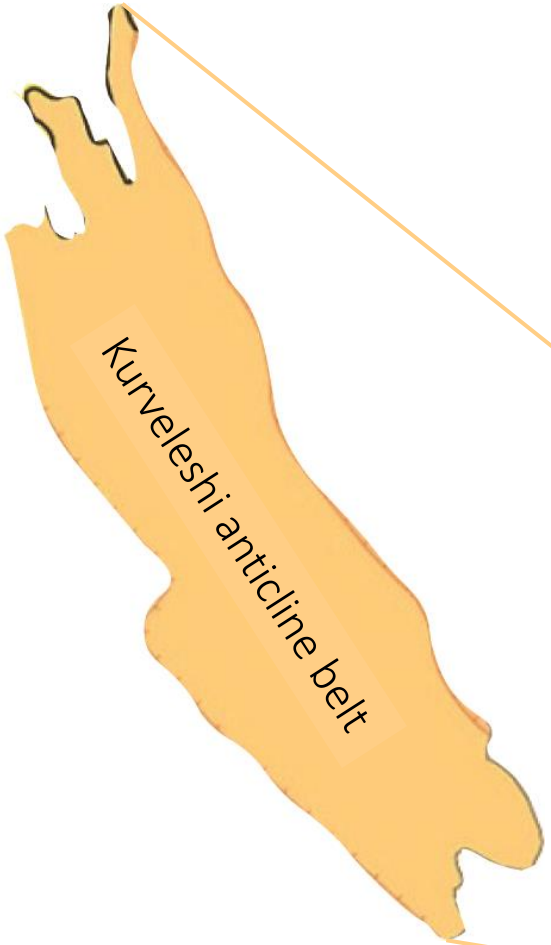
Turkey, ongoing

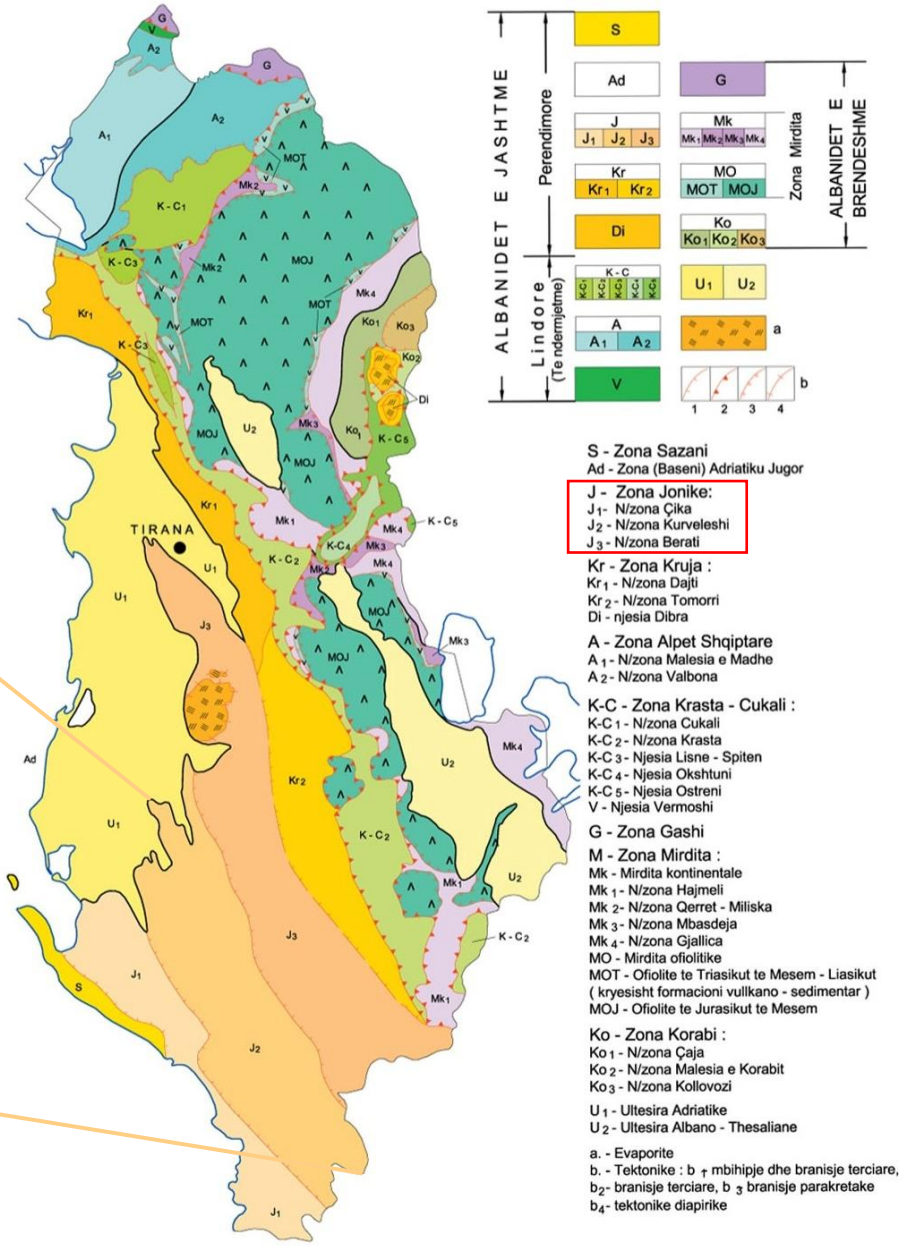
Phosphoric Acid Plant

DAP 18-46-0 (Diammonium Phosphate Fertilizer)

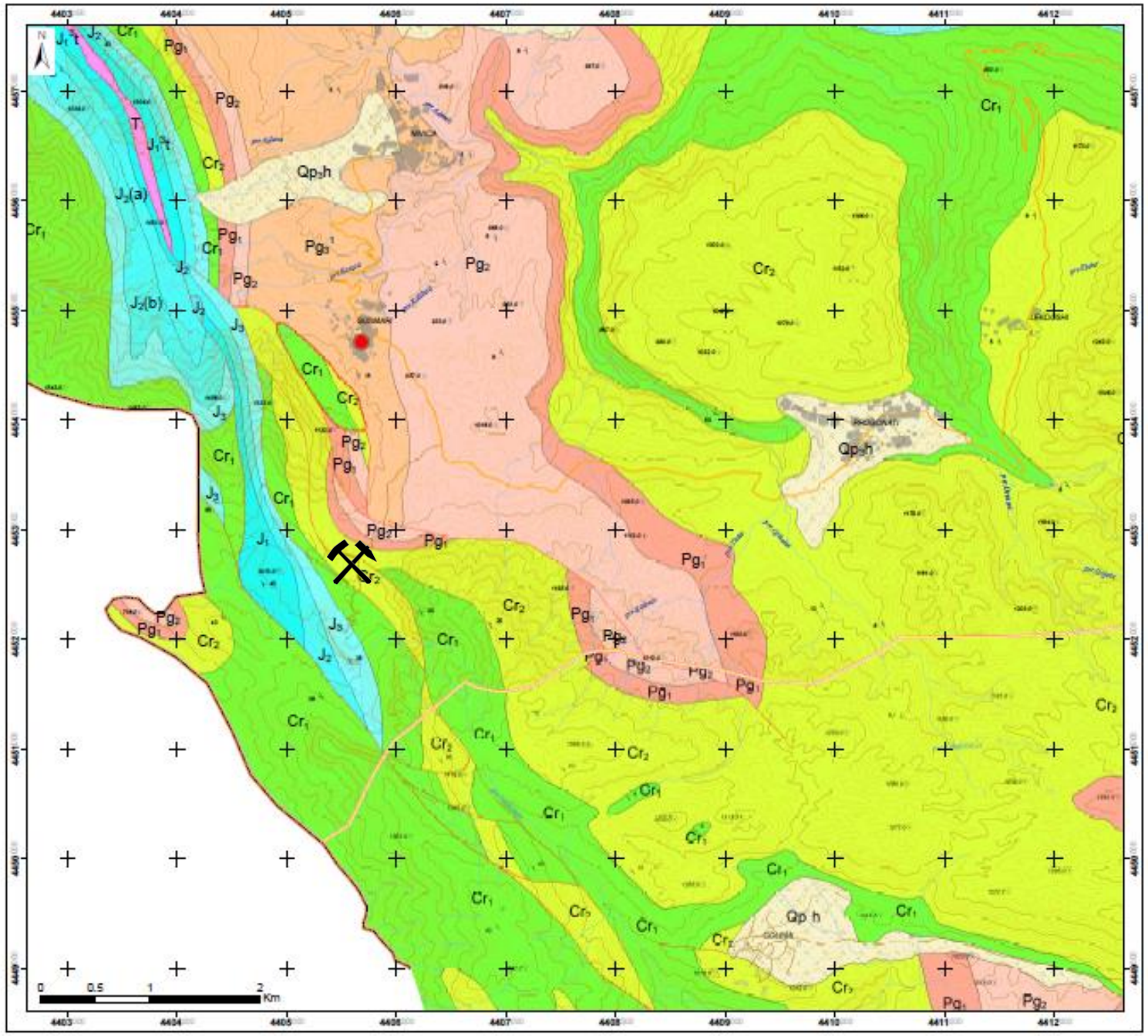
Source, ETI GUBRE

Geological setting of Albania

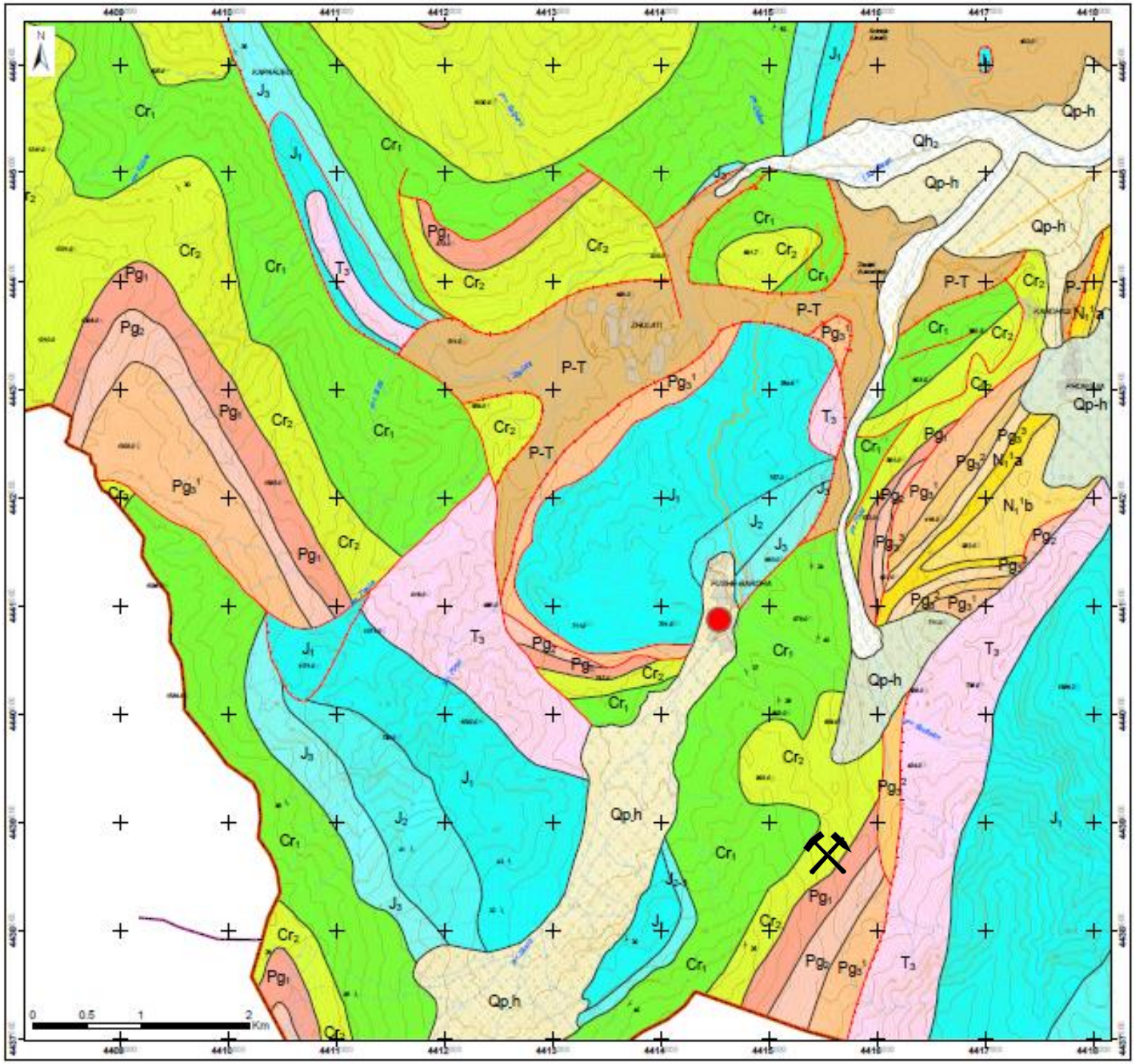




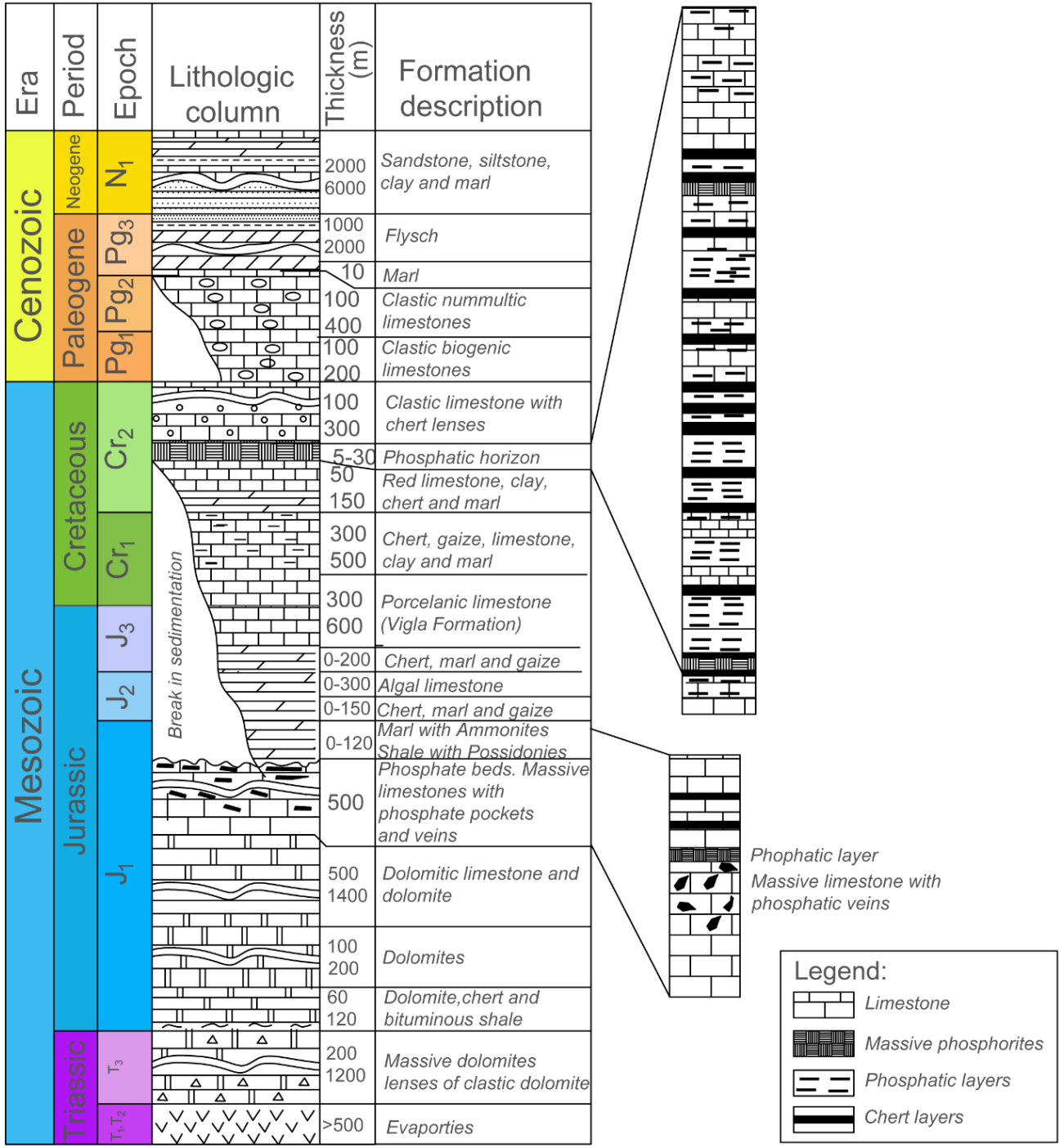
Tectonic scheme of Albanides



Geological map of Gusmari deposit

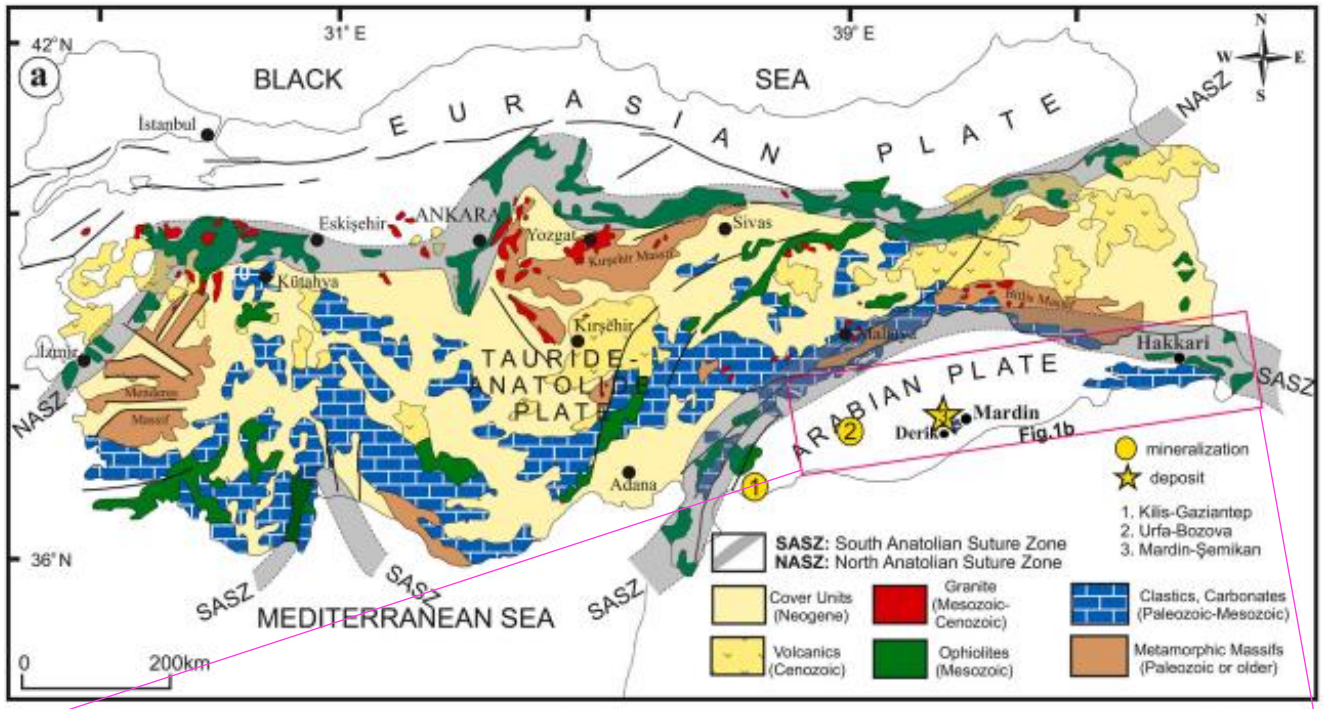


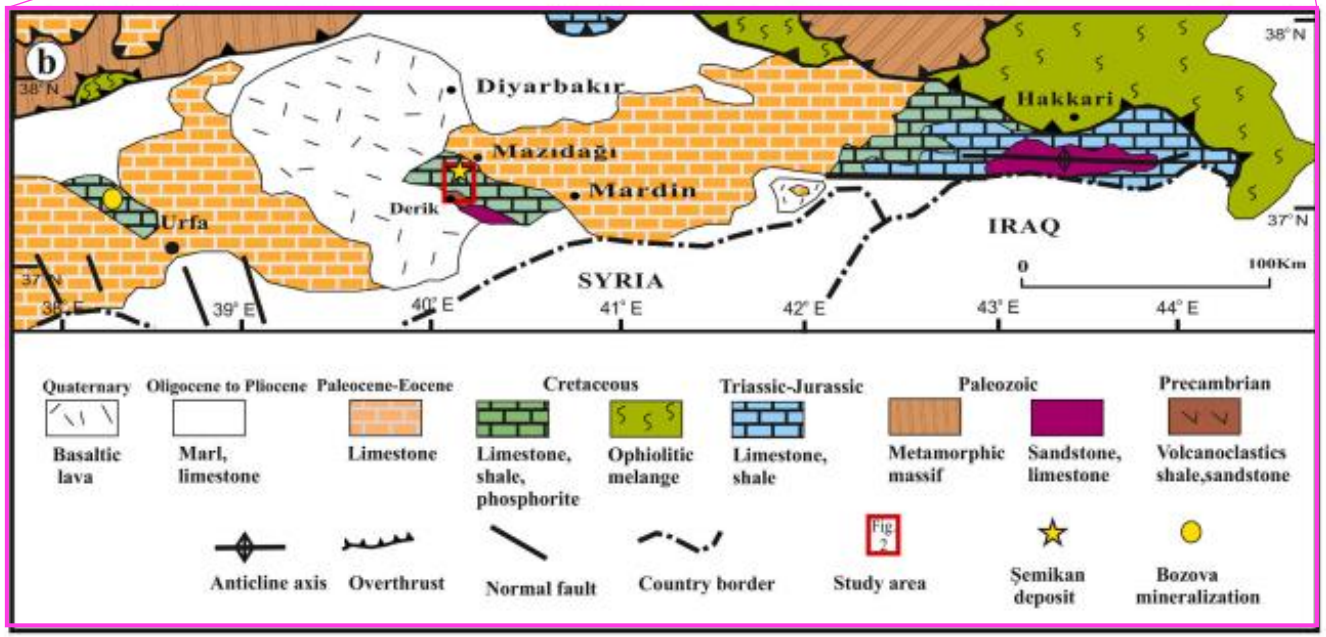
Geological map of Fushëbardha deposit



Generalized stratigraphic column of the Ionian zone and detailed phosphate horizons position (modified Serjani A., 1991)

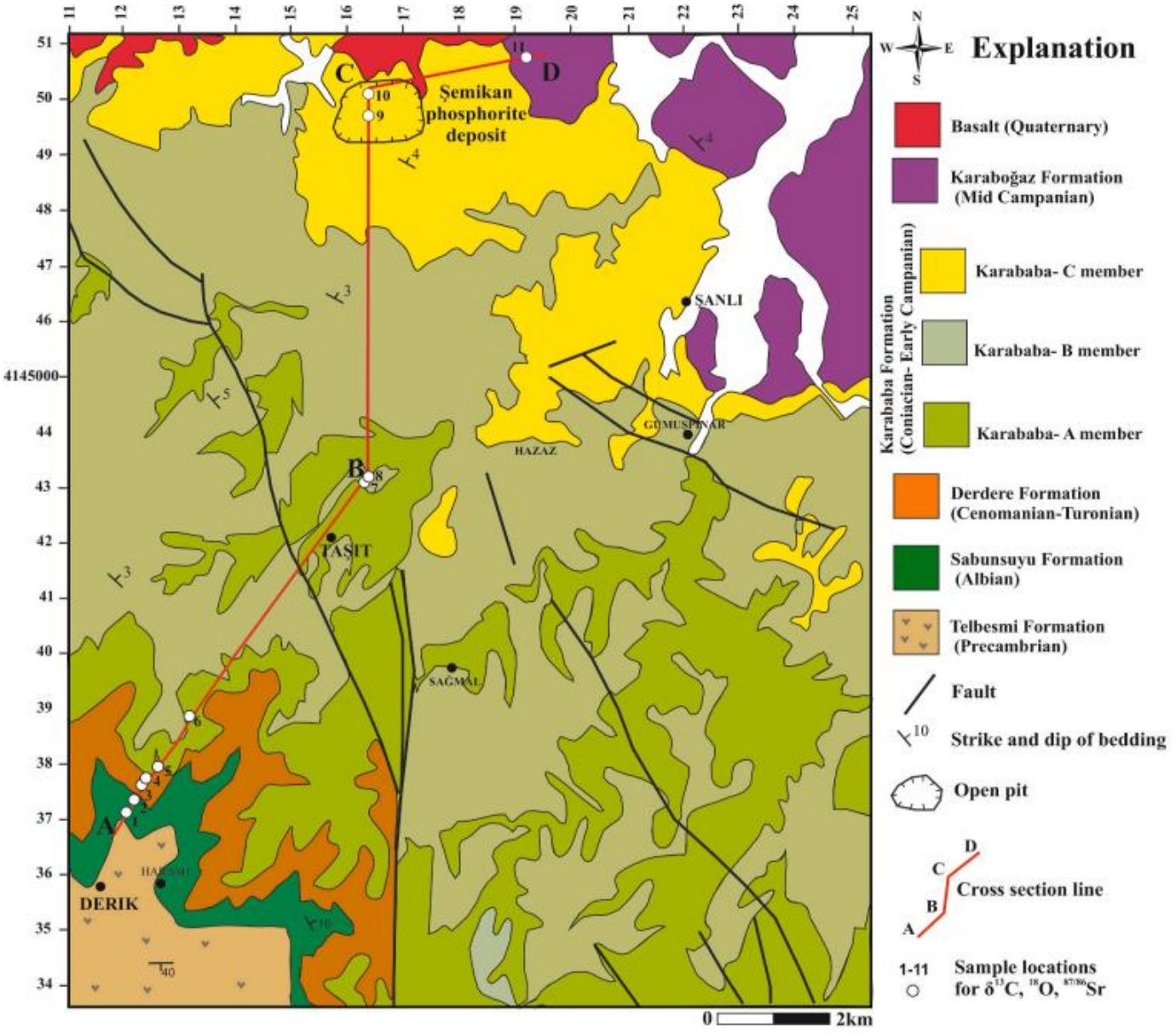
Geological framework of the study area in Turkey

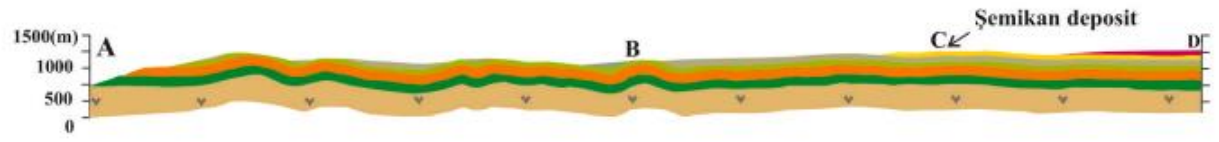


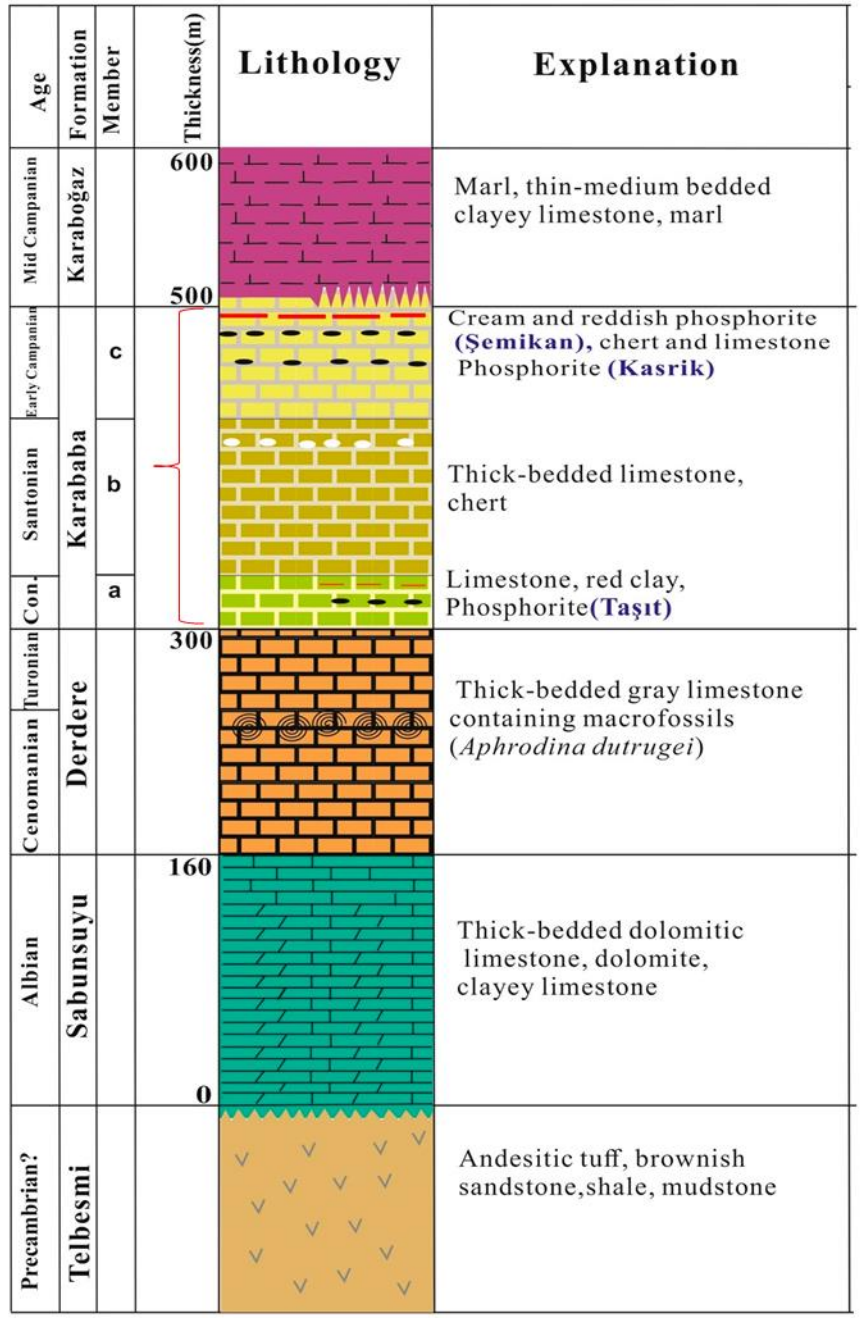


a) Simplified geological map of Turkey showing the main tectonic units (Anatolides, Taurides, Arabian Platform).

b) Harta gjeologjike e Anadollit juglindor dhe zonës së Derikut (Sengör dhe Yılmaz , 1981).





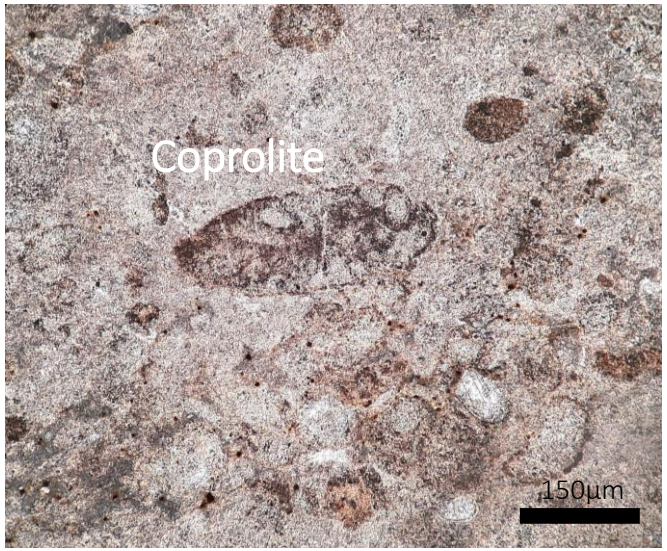


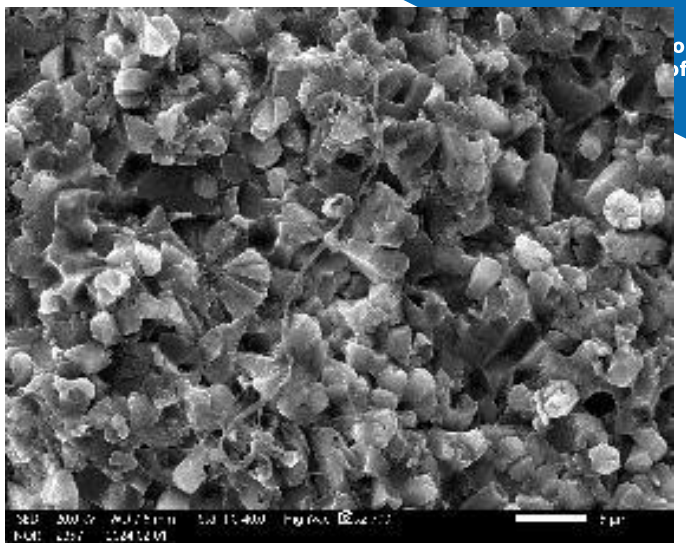
Stratigraphic column of Derik–Mazıdağı region (Ozturk and Ghasemian, 2022)

Abandoned Gusmari deposit

Gusmar (Optical microscopy and SEM-EDS)

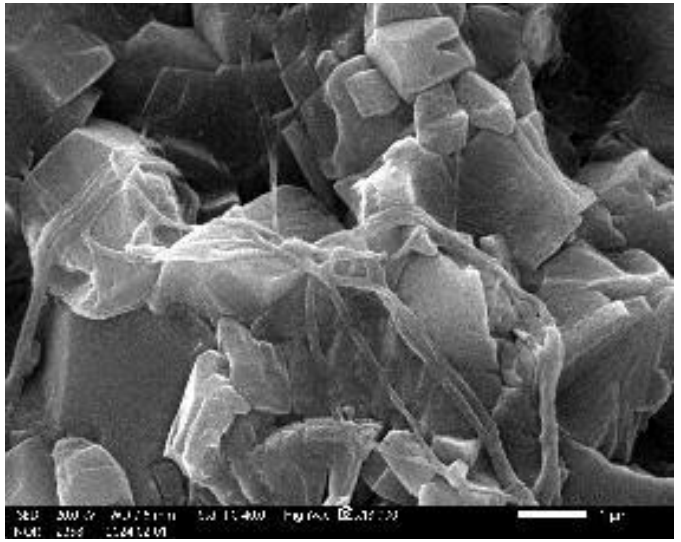
Mudstone with phosphatic laminae, and calcite veins.



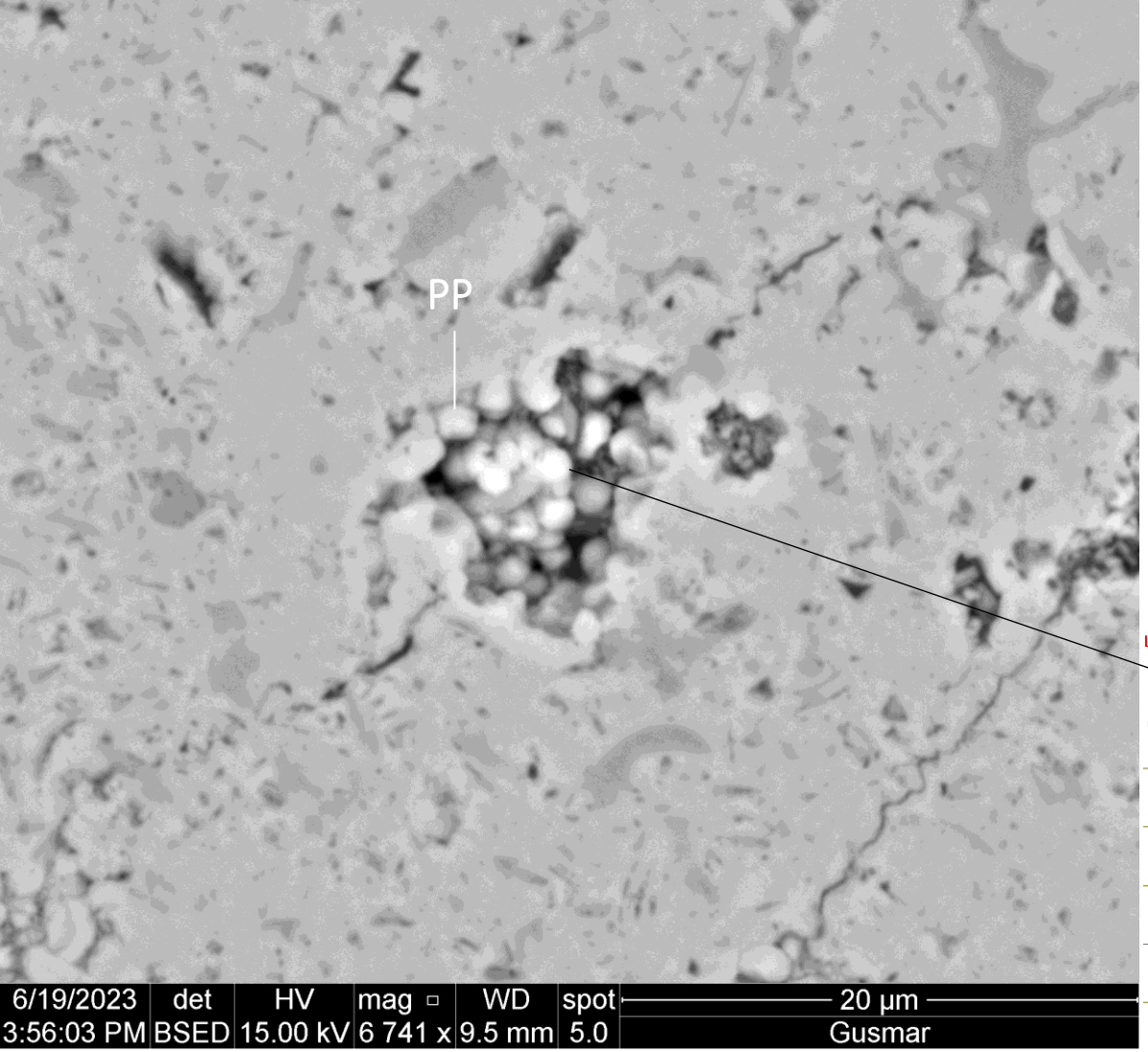


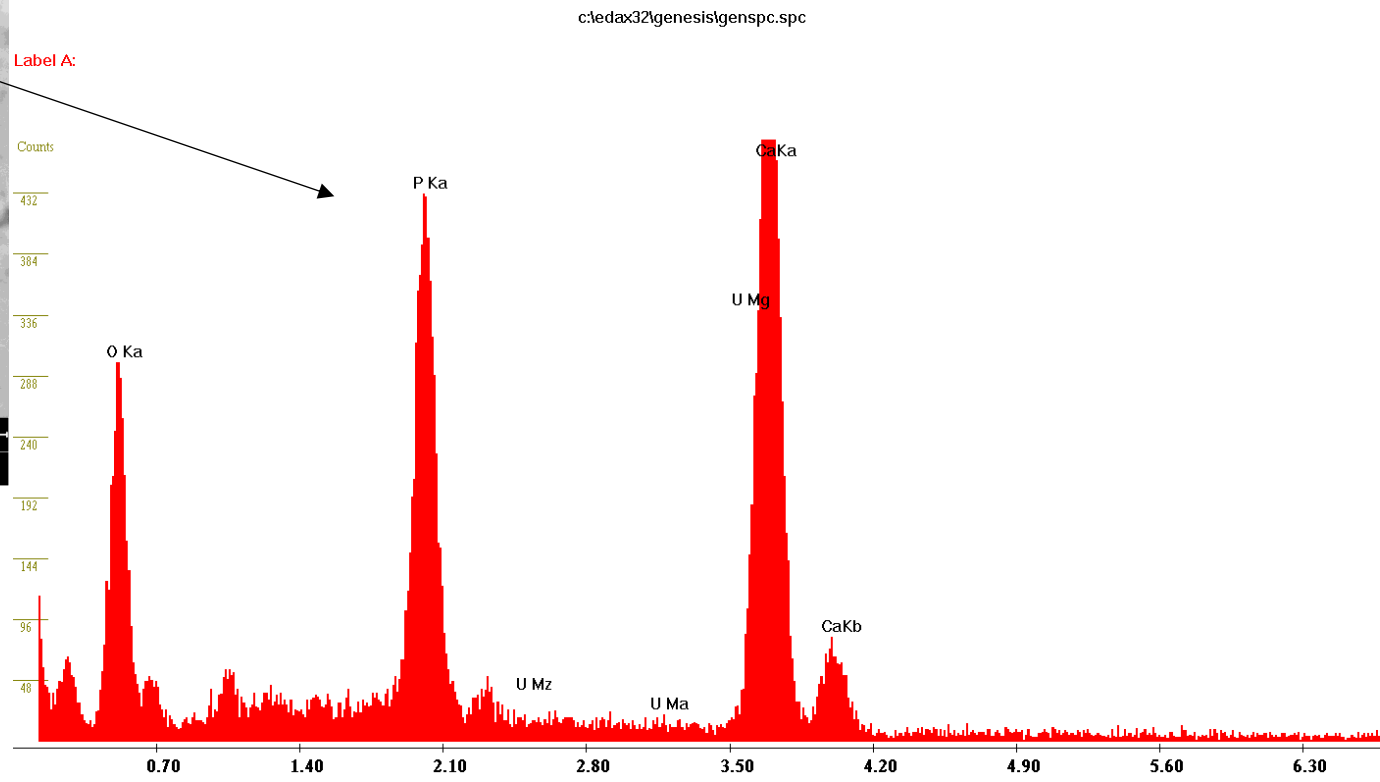
Prismatic apatite crystals form spherulites around detrital calcite and microbial filament.

Globotruncarid planktonic foraminifers indicative of Late Cretaceous (probably Coniacian) age. (Edgell, 1957)



EPS or microbial mats coating apatite crystals


PP
6/19/2023 det HV mag WD spot 20 µm
3:56:03 PM BSED 15.00 kV 6 741 x 9.5 mm 5.0 Gusmar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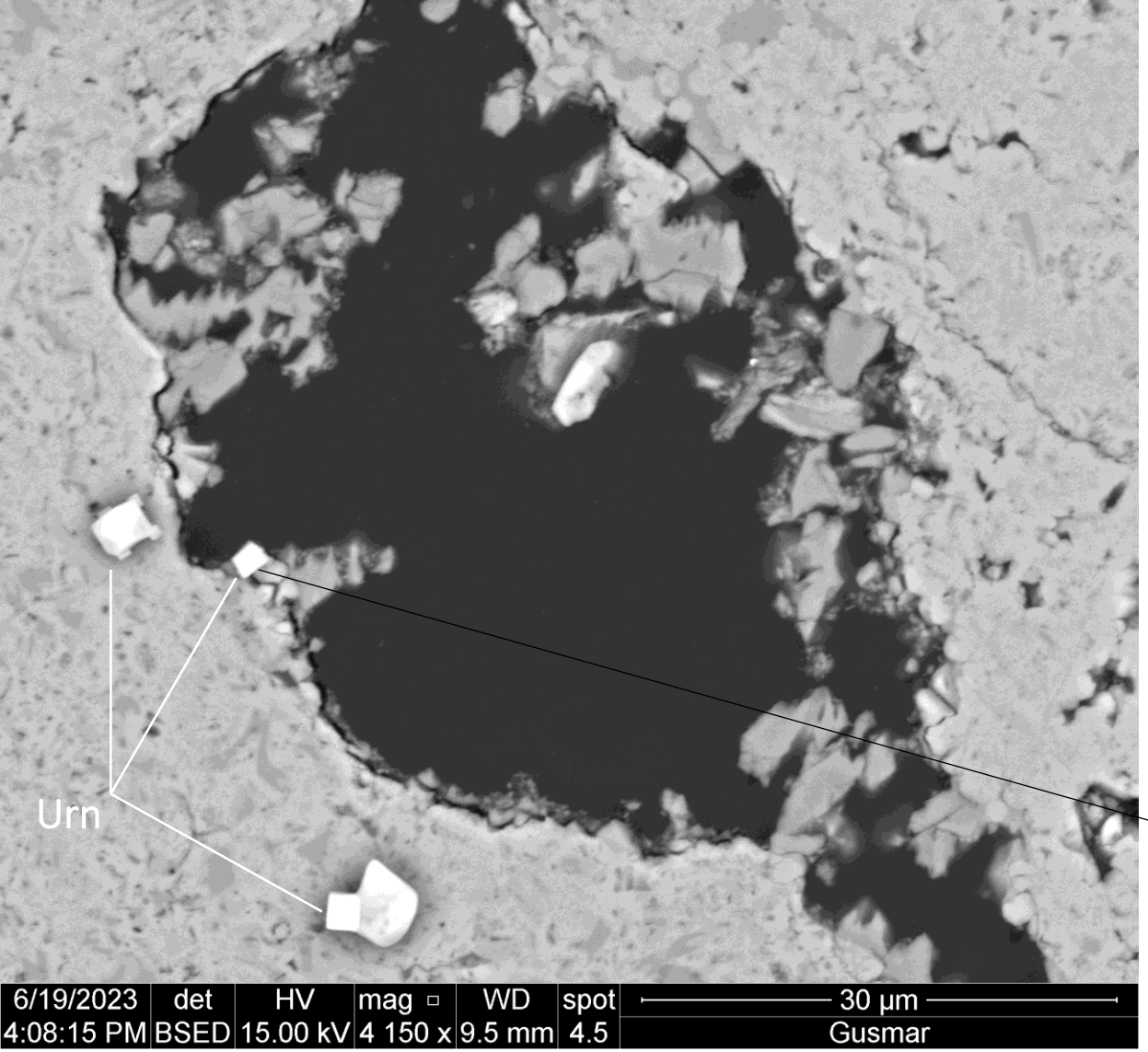
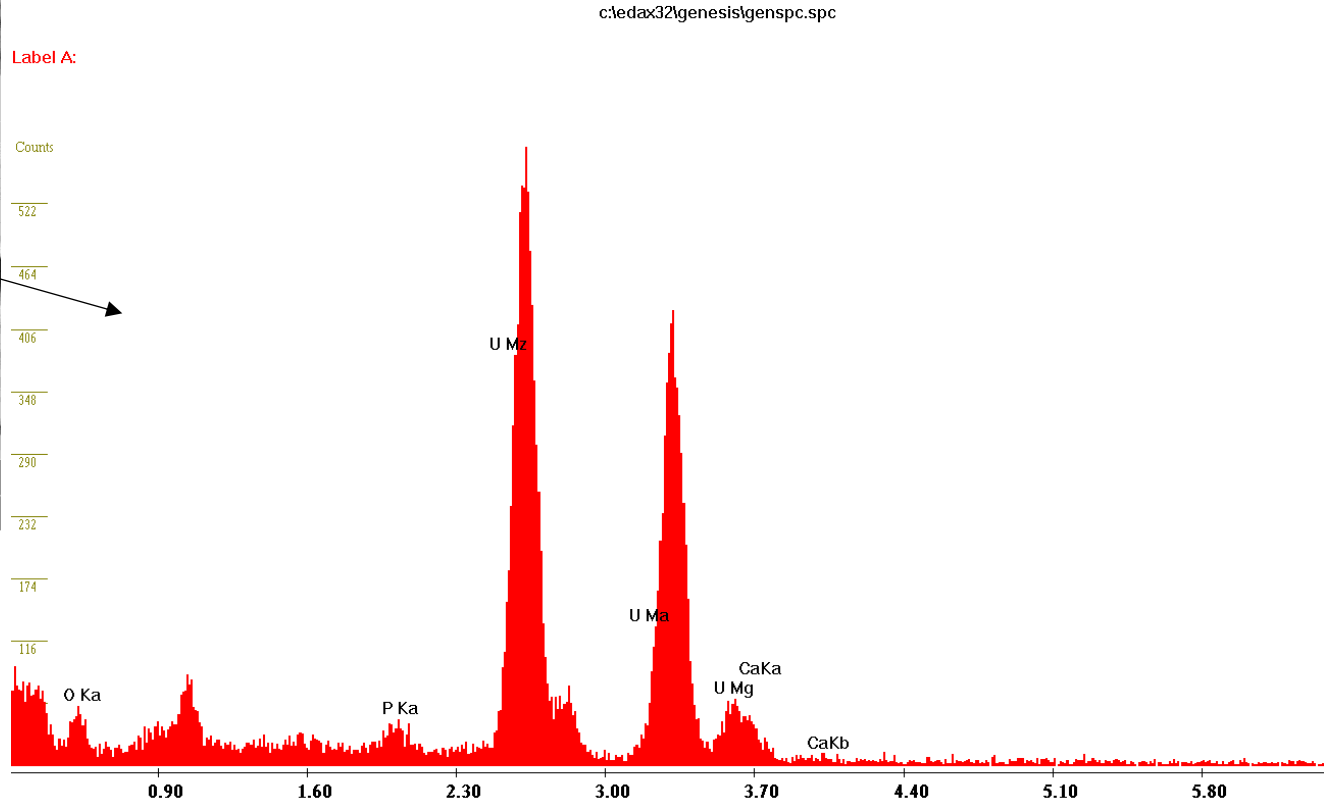
Label A:
Counts
O Ka
P Ka
U Mz
U Ma
U Mg
CaKa
CaKb
0.70
1.40
2.10
2.80
3.50
4.20
4.90
5.60
6.30


Urn
6/19/2023 | det | HV | mag | WD | spot | 30 µm
4:08:15 PM | BSED | 15.00 kV | 4 150 x | 9.5 mm | 4.5 | Gusmar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290
232
174
116
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U Ma
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P Ka
CaKa
U Mg
CaKb
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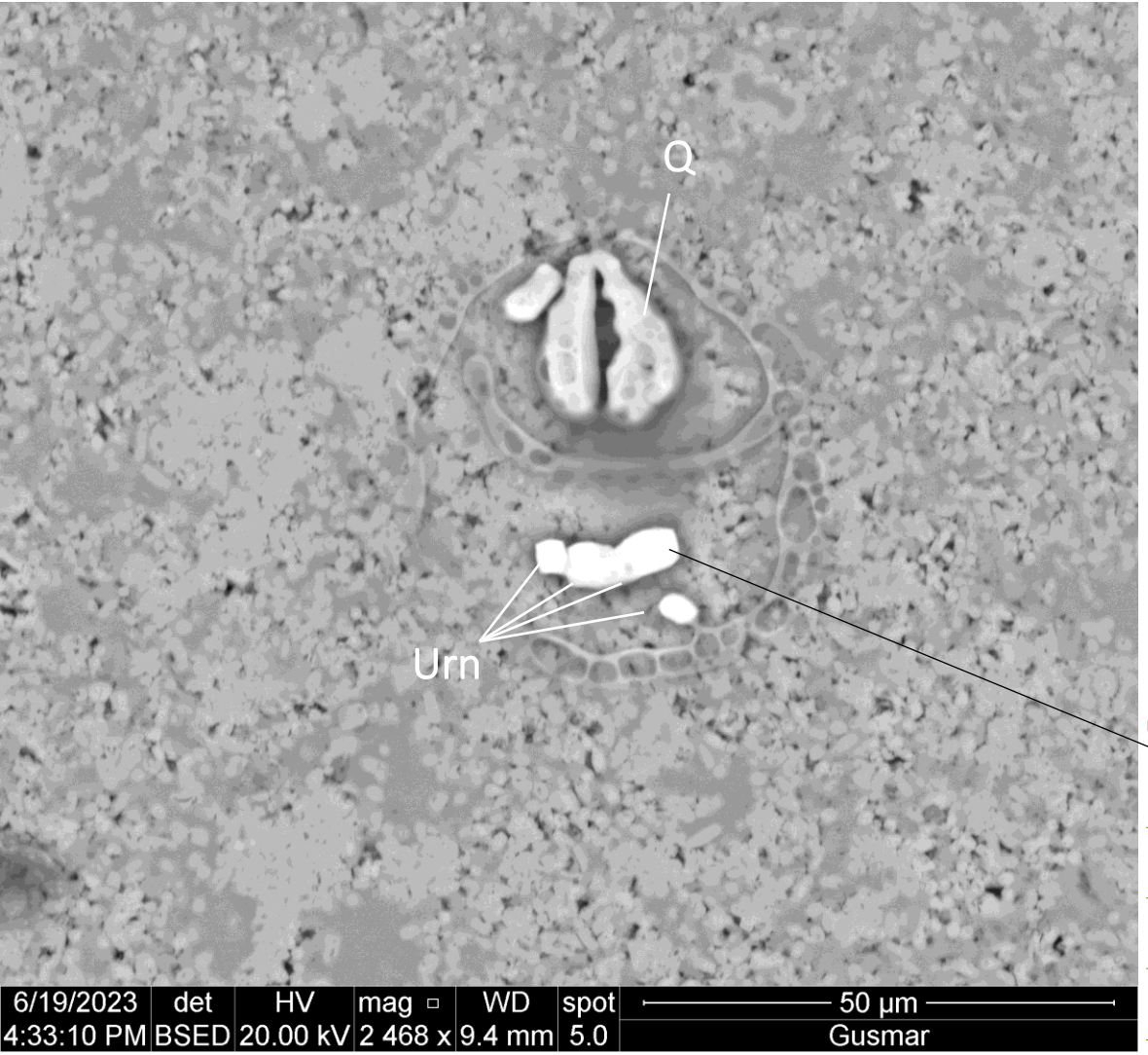
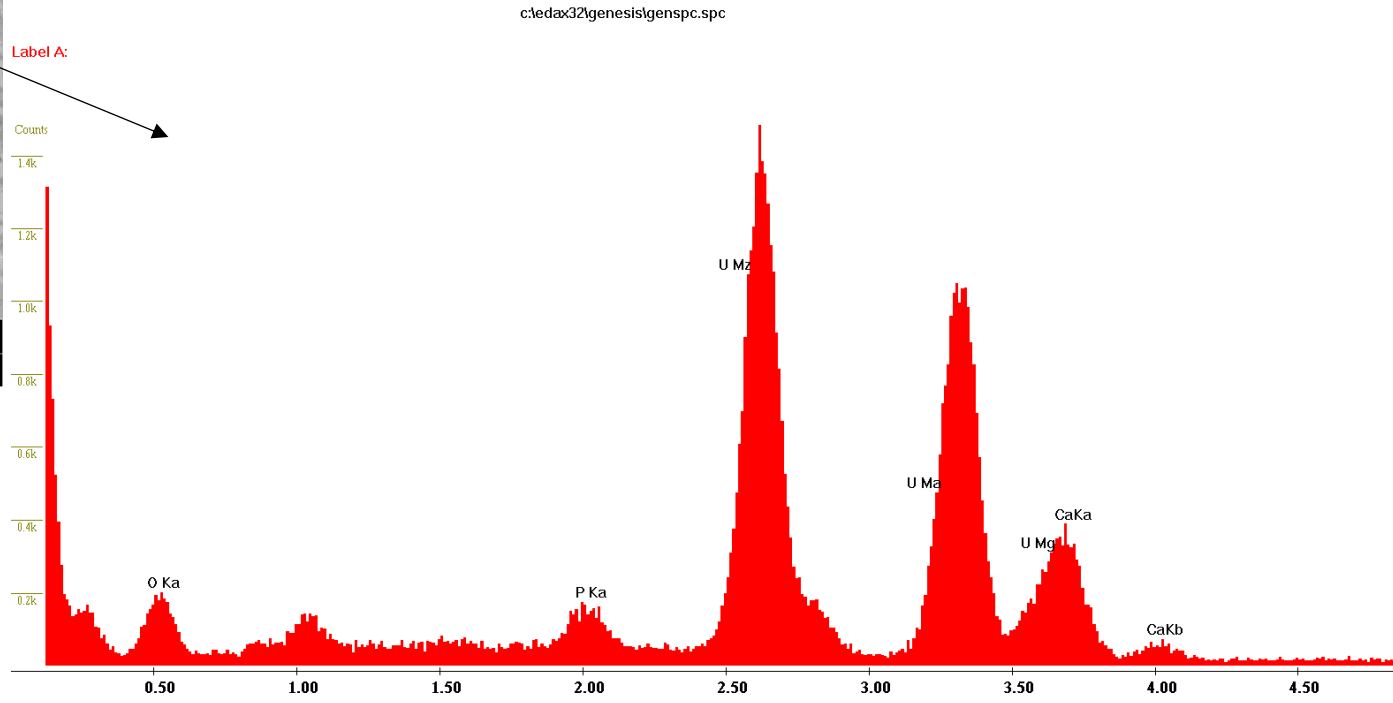
1.60
2.30
3.00
3.70
4.40
5.10
5.80


Q
Urn
6/19/2023 4:33:10 PM
det BSED
HV 20.00 kV
mag 2 468 x
WD 9.4 mm
spot 5.0
50 µm
Gusmar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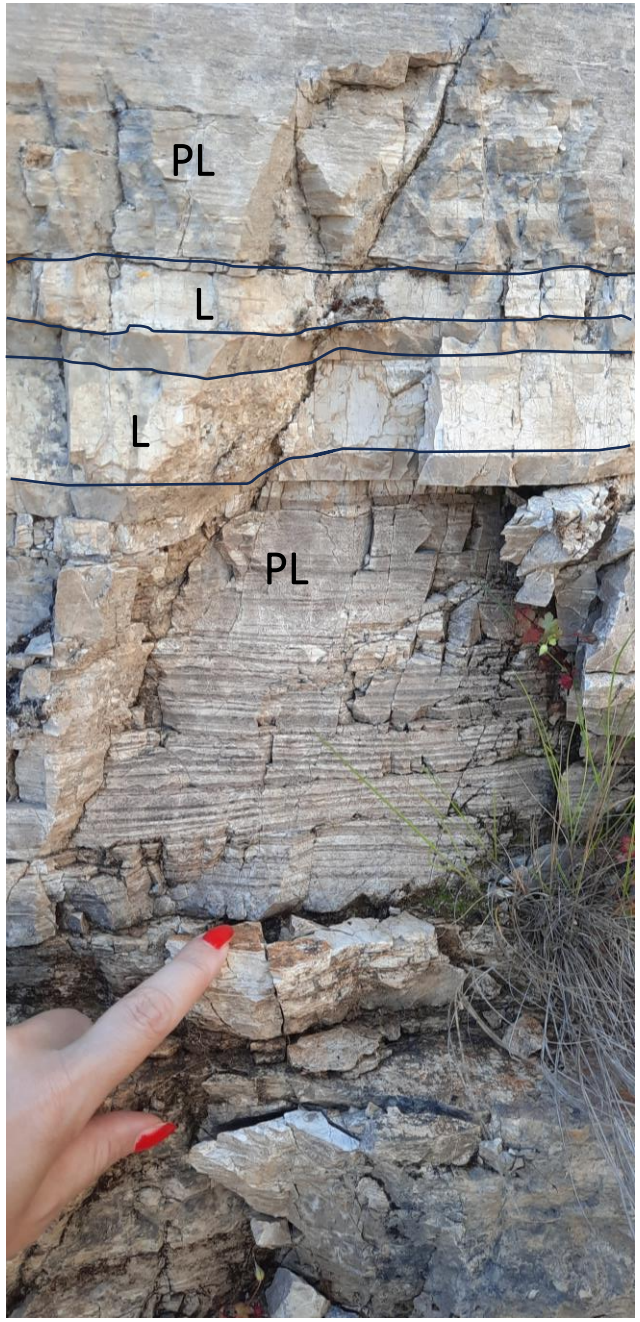
1.2k
1.0k
0.8k
0.6k
0.4k
0.2k
O Ka
P Ka
U Mz
U Ma
U Mg
CaKa
CaKb
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50

Abandoned Fushëbardha deposit



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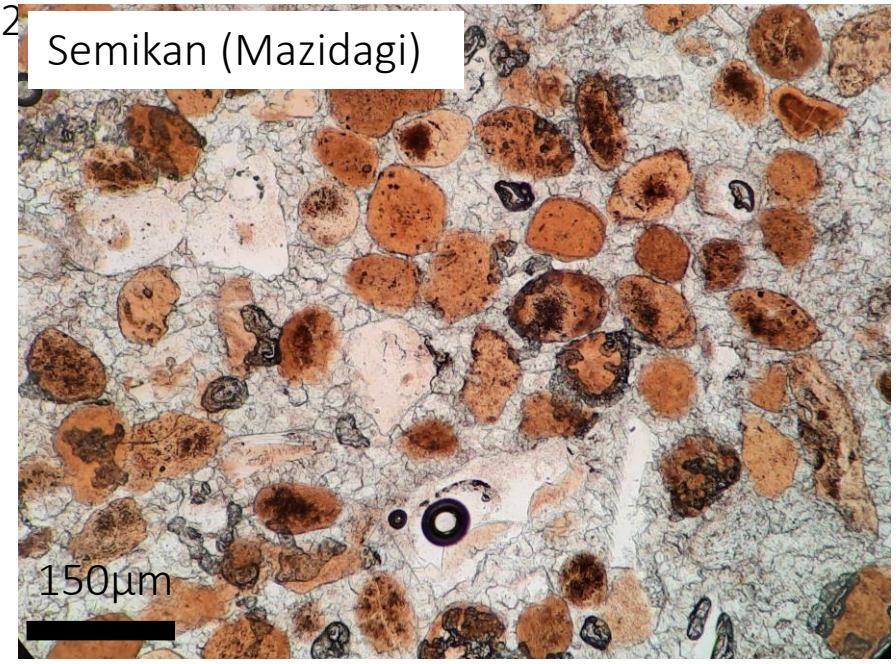
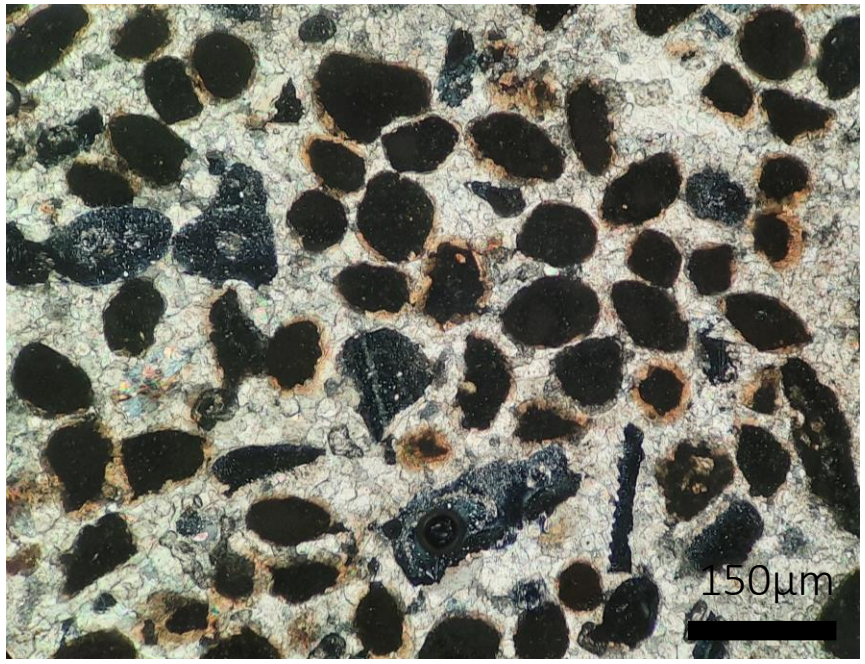
Active exploitation in Mazidagi deposit

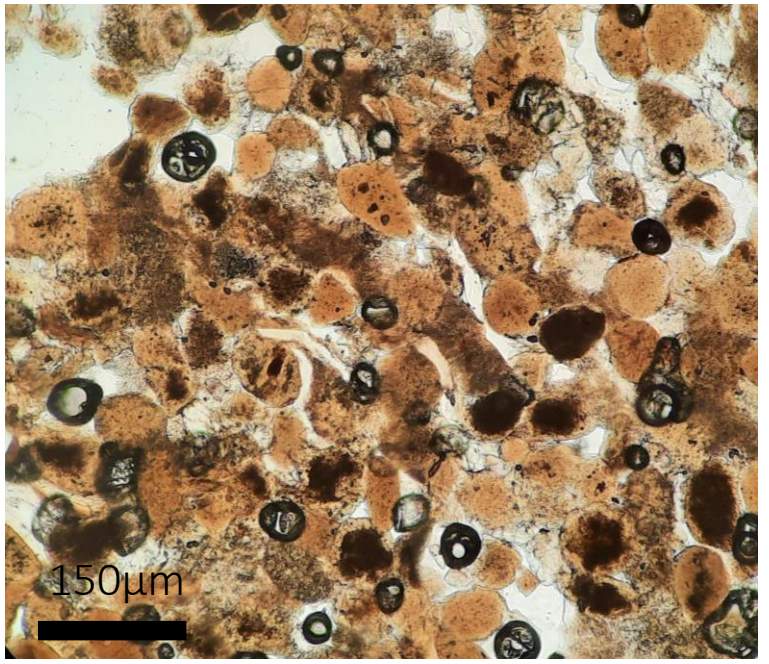
Active exploitation in Mazidagi deposit

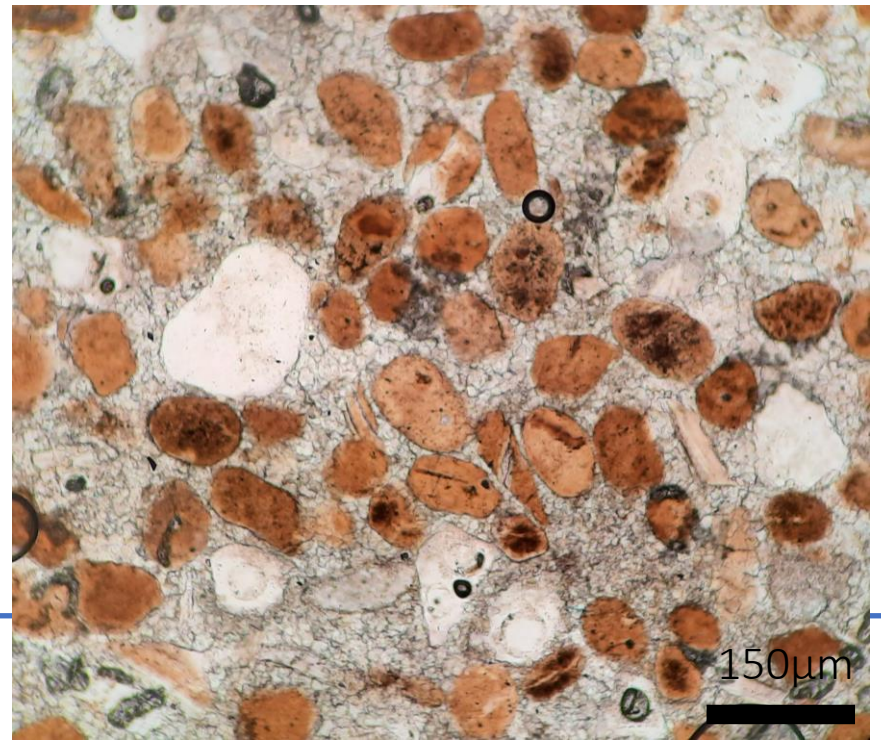
Active exploitation in Mazidagi deposit by Eti Gübre

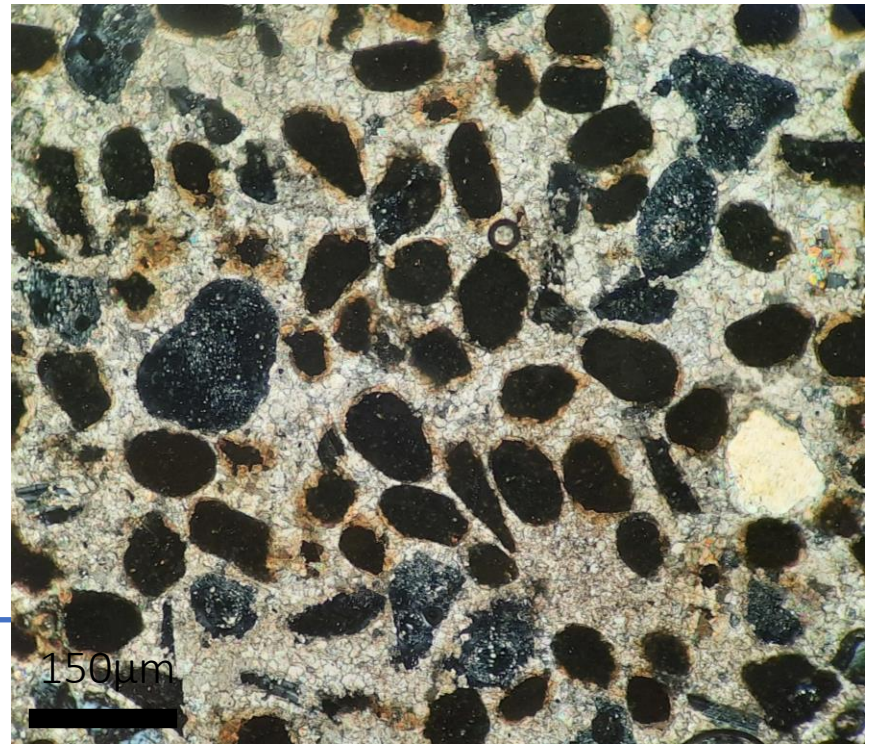
Semikan (Mazidagi)

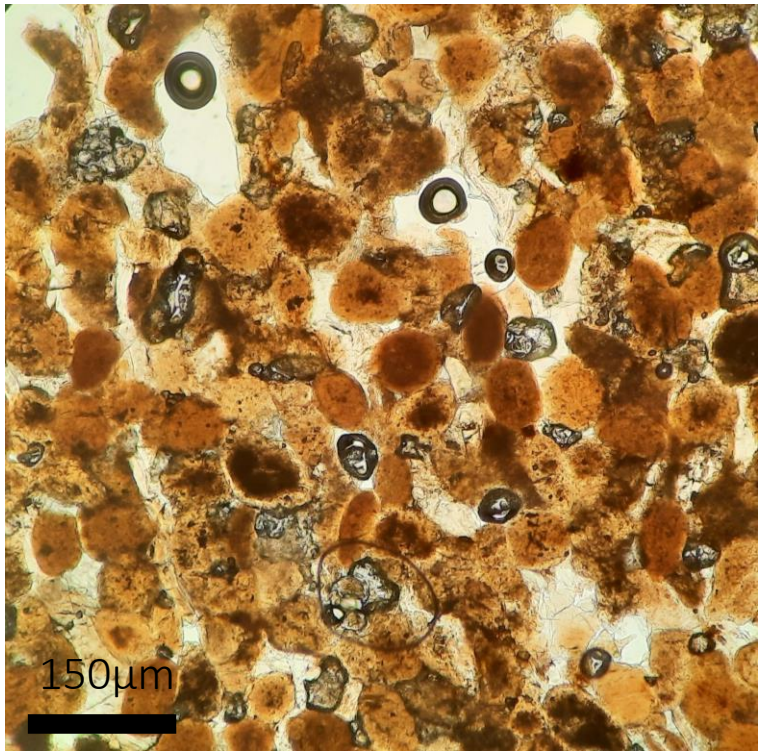






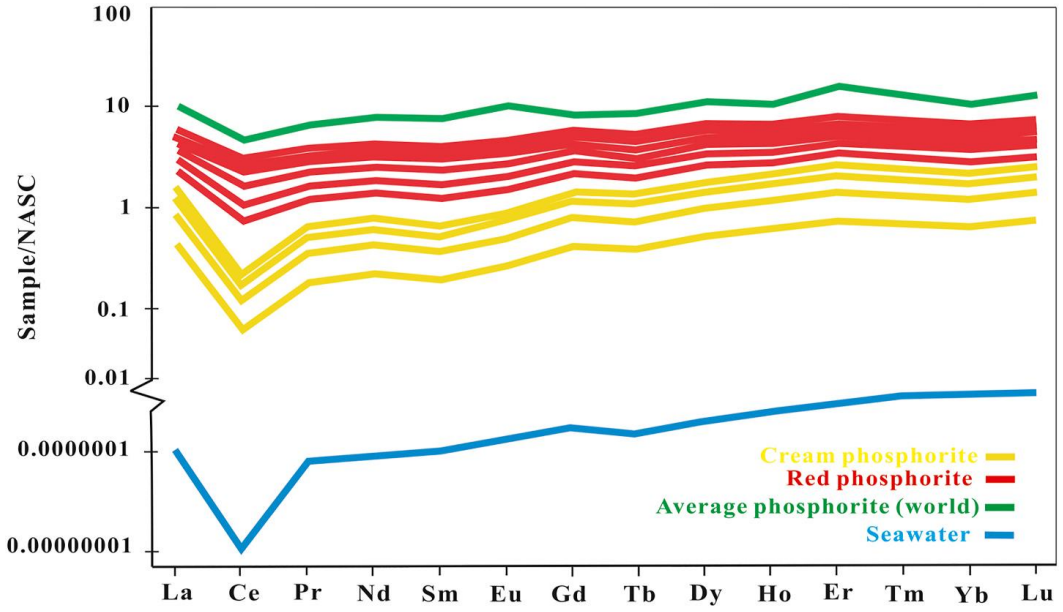






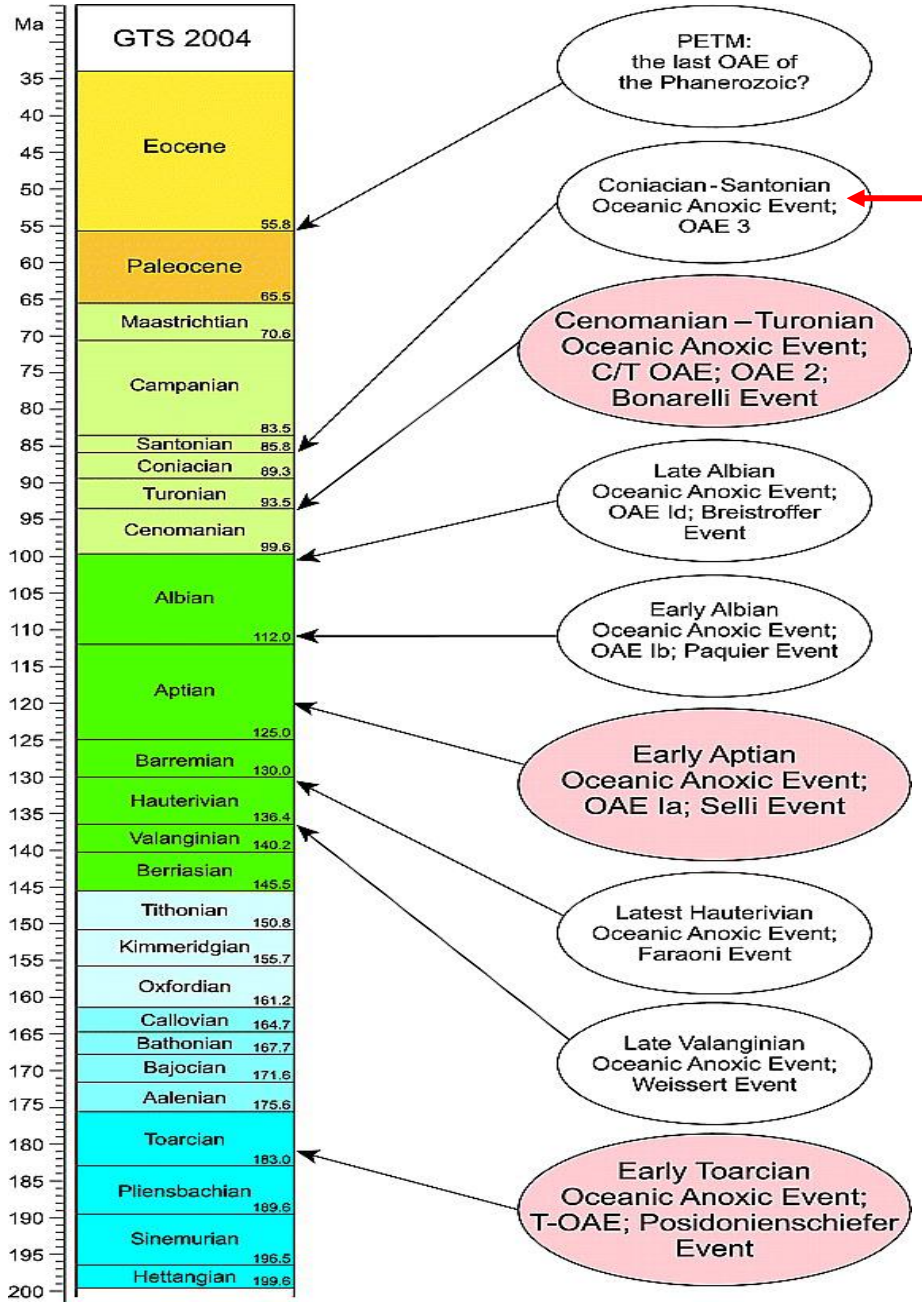
Rare-earth-element composition (ppm) of Şemikan phosphorites; CCP and RP, cream and reddish phosphorite, respectively.

Element	dl	CCP1	CCP2	CCP3	CCP4	RP1	RP2	RP3	RP4	RP5	RP6	RP Mean	CCP Mean
La	0.1	13.7	13.1	11.9	11	21.8	21	24.3	24.6	19.1	18	20.18	12.43
Ce	0.1	4.3	4	3.4	3.2	34.7	21.3	37.9	41.9	22.7	30.3	27.50	3.73
Pr	0	1.43	1.33	1.18	1.11	4.28	3.29	4.7	4.9	3.19	3.57	3.60	1.26
Nd	0.3	6.2	5.7	4.9	4.9	16.6	12.5	17.7	18.3	12.8	13.8	13.88	5.43
Sm	0.1	1.11	0.98	0.83	0.79	3.23	2.5	3.68	3.66	2.42	2.67	2.73	0.93
Eu	0	0.32	0.27	0.25	0.2	0.75	0.6	0.8	0.85	0.59	0.58	0.63	0.26
Gd	0.1	2.06	1.88	1.76	1.48	3.4	3.22	3.92	3.68	2.83	2.69	3.08	1.80
Tb	0	0.31	0.29	0.25	0.21	0.51	0.47	0.59	0.56	0.43	0.43	0.47	0.27
Dy	0.1	2.21	1.94	1.77	1.73	3.28	3.17	3.37	3.63	2.74	2.61	2.96	1.91
Ho	0	0.64	0.56	0.54	0.43	0.64	0.75	0.78	0.74	0.67	0.56	0.67	0.54
Er	0	2.07	1.92	1.8	1.57	2.24	2.44	2.45	2.24	2.11	1.71	2.15	1.84
Tm	0	0.28	0.27	0.25	0.21	0.31	0.33	0.34	0.33	0.28	0.23	0.30	0.25
Yb	0.1	2	1.71	1.55	1.41	1.96	2.34	2.29	2.11	2.03	1.6	2.00	1.67
Lu	0	0.35	0.3	0.27	0.24	0.3	0.39	0.36	0.36	0.32	0.26	0.33	0.29
Ce/Ce*		0.17	0.17	0.16	0.16	0.77	0.53	0.85	0.69	0.6	0.82	0.71	0.17
Pr/Pr*		1.27	1.28	1.35	1.27	0.98	1.1	1	0.99	1.02	0.99	1.05	1.29



Geochemical Differences in Phosphorites, the Semikan phosphorite deposit in SE Turkey contains two main types of phosphorites: cream-colored (CCP) and reddish (RP). CCP is enriched in U, Ca, Na, and Y, while RP is enriched in Al, Mg, K, Ti, Zr, Ga, Cr, Fe, and rare-earth elements (REEs). (Ghasemian et al. 2022)

Geochemistry of oceanic anoxic events



The presence of pyrite disseminations, iron-manganes-hydrooxides, organic matter and traces of such elements as Pb, Zn, Ag, in phosphate layers, testify to the formation in a pelagic, reduced environment, at levels of depth with minimum oxygen (Slansky M., 1980).
The presence of siliceous thin beds, which are intercalated with carbonate and phosphate beds, testify about the sedimentation in deep see environment, in the deepest parts of the Ionian Basin.

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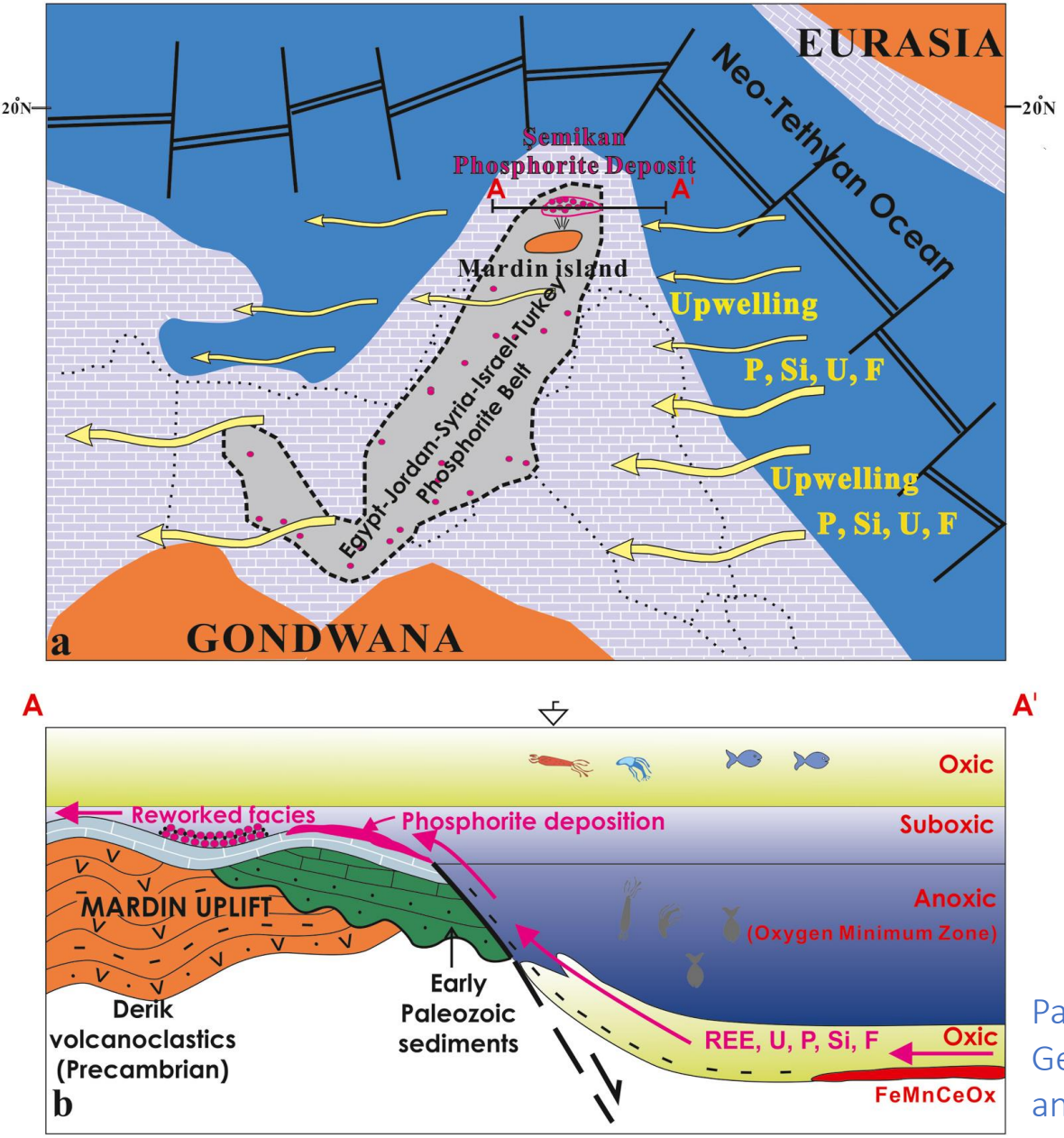

Phosphorite Deposition Mechanism, the formation model for the Semikan phosphorite deposit involves the pumping of nutrient-rich, oxic deep ocean waters into shallow seas, causing plankton blooms and subsequent phosphorite precipitation. The primary thin phosphate layers were reaccumulated in local depressions, resulting in thicker deposits. The presence of reddish soil in the phosphorite layers indicates terrestrial input from a neighboring island.

Paleogeographic map of Middle East region during Early Campanian. (a) Geotectonic setting of phosphorite deposits in Egypt, Jordan, Syria, Israel, Iraq, and Turkey; (b) formation model for Mazıdagı phosphorite deposit.

Acknowledgements

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Funded by the European Union

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AKKSHI

TÜBİTAK

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