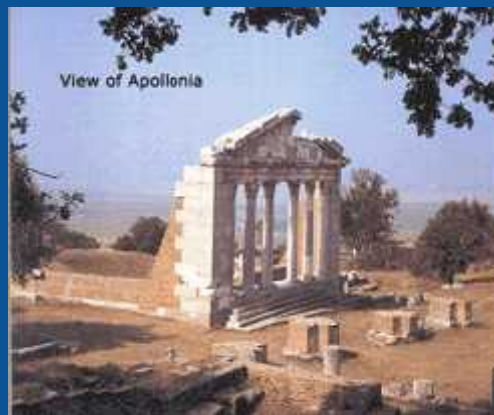


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View of Apollonia

Layout of Square in Academy of Sciences, Castle of Tirana, Albania, where ERT technique is used.



Academy of Sciences Square

STUDIM EMERGJENT ARKEOLOGJIK I KALASE SE TIRANES NEPERMJET TEKNOLOGJIVE TE REJA GJEOFIZIKE TE ERT DHE GJEORADARIT

Projekti nr: M8700057 (230), M8700058(231)

Drejtues Dr. Hamza Recı, IGJEUM, UPT,

Bashkepunetore: Dr. Idriz Jata, IGJEUM

Akademik Salvatore Bushati, AShSh

Marin Haxhimihali, MK, Parku Arkeologjik Apollonia

Workshop i organizuar nga AKTI, ne kuader te projekteve 2010-2014, Tirane 15 Nentor 2014.

H. Recı, IGJEUM, UPT, e-mail: reci.jack@gmail.com

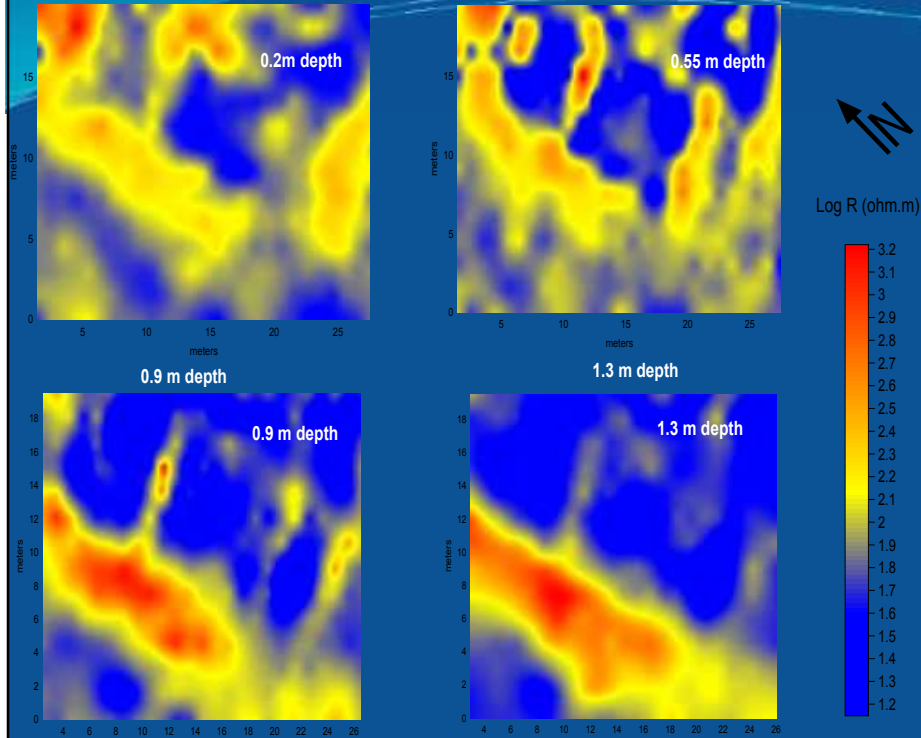
PERMBLEDHJE

1. SITUACIONI PËRFUNDIMTAR I SHPENZIMEVE TË PROJEKTIT
2. OBJEKTIVAT E PROJEKTIT
3. ARRITJET E PROJEKTIT
4. VAZHDIMESIA E PROJEKTIT
5. METODOLOGJIA E PERDORUR
6. REZULTATET E PUNIMEVE EKSPERIMENTALE
7. FALENDERIME

1. SITUACIONI PËRFUNDIMTAR I SHPENZIMEVE TË PROJEKTIT

Nr	Emertimi	Financimi (mije Leke)							
		Nga Mash		Nga Ministria		Nga vete		Gjithsej	
		plan	fakt	plan	fakt	plan	fakt	plan	fakt
1	Shpz. për rritjen e Aktiveve të Qëndrueshme të patrupëzuara	819	769	-	-	-	-	819	769
2	Shpz. për rritjen e Aktiveve të Qëndrueshme të trupëzuara	456	456					456	456
Totali		1275	1225	-	-	-	-	1275	1225

H. Reci, 2011. Images of true resistivity values in different depths in thermal baths (square 1), Apollonia, Albania. Results taken from Resistivity Tomography Profiles. Dipole-Dipole Array, 30 simultaneous electrodes used, distance between profiles 1.5m, distance between electrodes 1m.



2. OBJEKTIVAT E PROJEKTIT

- Transferimi dhe përdorimi i teknologjive të reja të rëlvimeve gjeofizike në studimet arkeologjike me rezolucion të lartë zgjidhjeje, me qëllim hartografimin 2D, 3D të objekteve arkeologjike të varrosura.
- Rritjen e kapacitetit grumbullues dhe interpretues të të dhënave, nëpërmjet inversionit të parametrave të matur.
- Rritje e nivelit kërkimor-shkencor në Gjeofizikën e aplikuar



Workshop i organizuar nga AKTI, në kuadër të projekteve 2010-2014, Tirane 15 Nentor 2014.

H. Reci, IGJEUM, UPT, e-mail: reci.jack@gmail.com

3. Arritjet e projektit

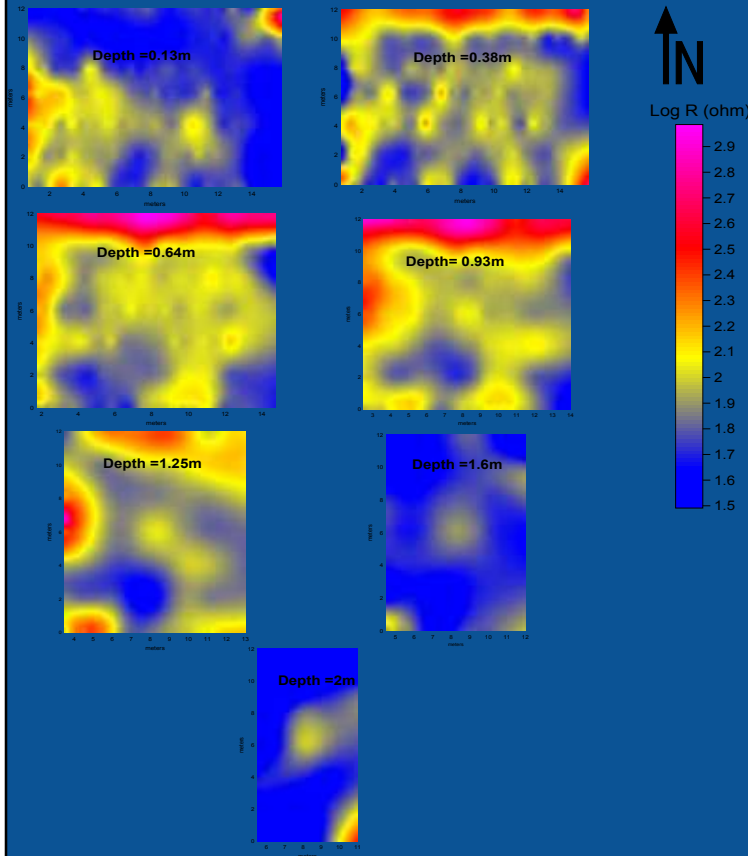
H. Reci, 2010. True resistivity values images in different depths in Tirana castle area, Albania. Results taken from Resistivity Tomography Profiles. Wenner Array, 30 simultaneous electrodes used, distance between profiles 1m, distance between electrodes 0.5 m.

- Metodologjite e perdorura ne zonat eksperimentale ato te ERT, Mag dhe EM jane inkurajuese.

- Pjesemarrje te shkencetareve te rinj, sidomos ne punimet fushore dhe cikleve te leksioneve te organizuara me studente te UPT.

- Metodologjite aplikuar ne kete studim, mund te perdoret gjeresish perpara se te kryhet nje ekspedite germimi, te shpejta dhe me kosto te ulet ne krahasim me ekspeditat e germimit, si dhe i orientojne ato ne vendet me te favorshme ku duhet germuar.

- Zhvillimi i teknikave ERT, EM, ka ngritur ne nje stad te ri dhe bashkekohor, kerkimin shkencor ne fushen e gjeofizikes se aplikuar. Metodologjite e perdorura jane kryer ne baze te standarteve me te avancuara te grumbullimit dhe perpunimit te te dhenave.



3. Arritjet e projektit

Botime dhe prezantime:

1. H. RECI, I. JATA, S. BUSHATI., 2015. ERT Method for the detection of buried archaeological objects in Apollonia & Bylis, Albania, romanian report in physics, Volume 67, Number 2, 2015 (in print).
2. H. Reci, I. Jata, S. Bushati., 2013. Comparison Of Different Resistivity Arrays Using ERT At Two Archaeological Sites In Albania, Albanian Journal of Natural and Technical Sciences (AJNTS) 34, (1) 2013, pages 53-59.

Extended Abstract

1. The Use of ERT, Magnetic and EM High Resolution Methods in Archeological Sites - A Case Study in Apollonia, Albania

Authors: H. Reci, I. Jata, S. Bushati and M. Haxhimihali

Event name: 7th Congress of the Balkan Geophysical Society, Tirana, Albania, 7-10 October 2013

Language: English , www.eage.org

2. The Use of ERT method, for the Detection of Buried Objects in Archaeological Sites of Apollonia and Bylis, Albania

Authors: H. Reci, I. Jata and S. Bushati

Event name: Near Surface Geoscience 2012 - 18th European Meeting of Environmental and Engineering Geophysics, 3 - 5 September 2012, Paris, France.

Language: English , www.eage.org

Artikull paraqitur per botim tek AKTI

1. PËRDORIMI I METODAVE GJEOFIZIKE ME REZOLUCION TË LARTË ZGJIDHJEJE, NË SITET ARKEOLOGJIKE. RASTË STUDIMI NË KALANË E TIRANËS DHE APOLLONI

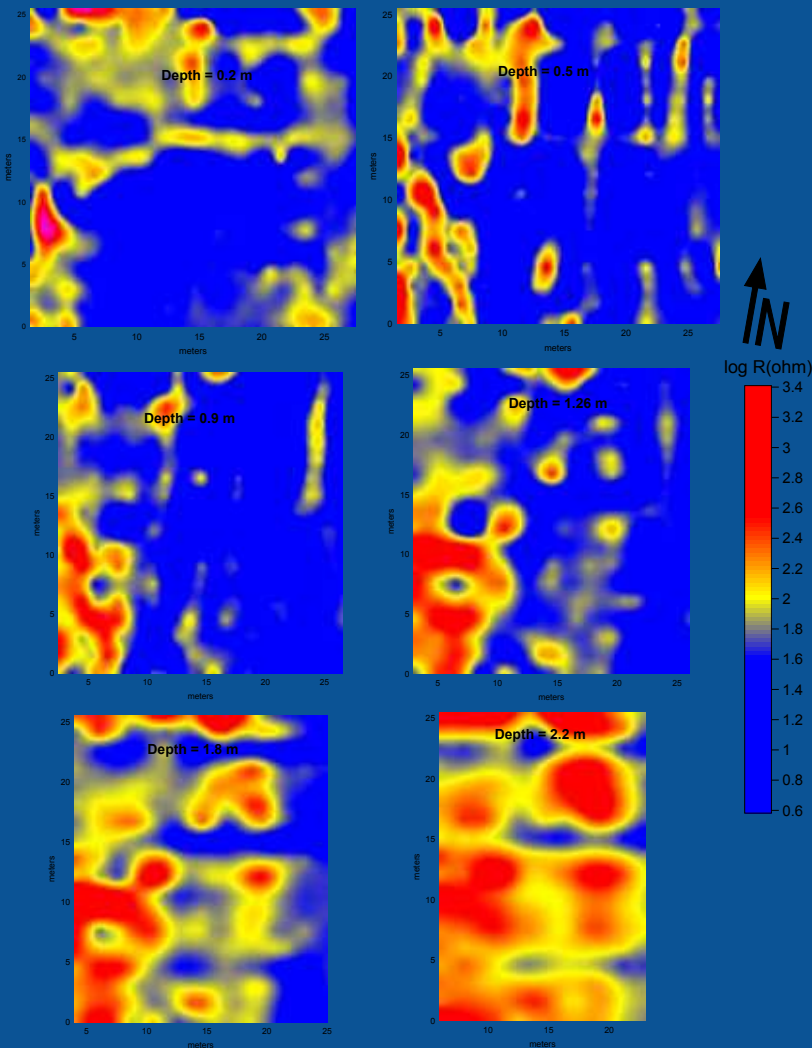
Hamza Reçi, Marin Haxhimihali, Salvatore Bushati, Idriz Jata,

Workshop i organizuar nga AKTI, ne kuader te projekteve 2010-2014, Tirane 15 Nentor 2014.

H. Reci, IGJEUM, UPT, e-mail: reci.jack@gmail.com

4. Vazhdimesia e projektit

H. Reci, 2010. True resistivity values images in different depths in Old Gymnasium area, Bylis, Albania. Results taken from Resistivity Tomography Profiles. Dipole-Dipole Array, 30 simultaneous electrodes used, distance between profiles 1.5m, distance between electrodes 1m.



➤ Ky studim shkencor dhe eksperimental sherben si baze per hartimin e projekteve te perbashketa me Institutin e Arkeologjise dhe ate te Monumenteve, apo edhe bashkepunetore nderkombetare me qellim mbrojtjen e trashegimise kulturore ne zonat arkeologjike si dhe zbulimin e rrenojave ekzistuese te varrosuara.

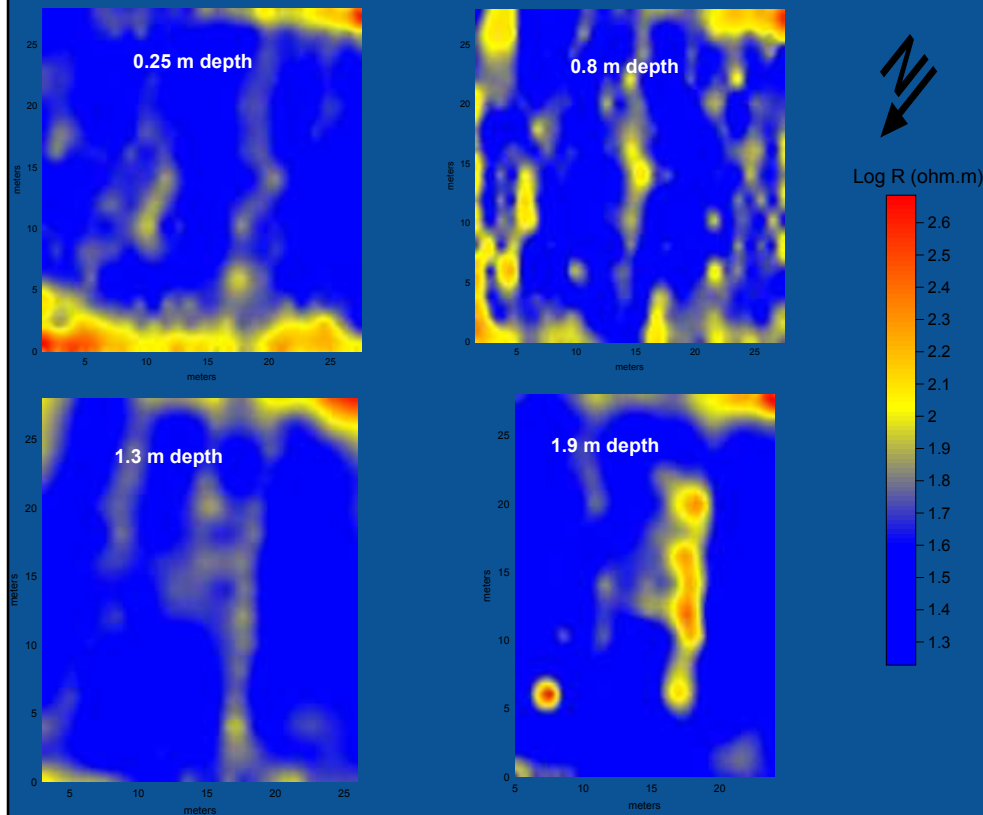
➤ Kerkimet e integruara gjeofizike dhe arkeologjike mund te ndermerren me projekte pilot per ti evidentuar dhe mbrojtur objektet arkeologjike te varrosura.

Workshop i organizuar nga AKTI, ne kuader te projekteve 2010-2014, Tirane 15 Nentor 2014.

H. Reci, IGJEUM, UPT, e-mail: reci.jack@gmail.com

4. Vazhdimesia e Projektit

H. Reci, 2011. True resistivity values images in different depths in thermal baths (square 3), Apollonia, Albania. Results taken from Resistivity Tomography Profiles. Wenner Array, 30 simultaneous electrodes used, distance between profiles 2m, distance between electrodes 1m.



- Rezultatet e ketij studimi jane te krahasueshme me ato te vendeve te zhvilluara. Kjo krijon mundesine e hartimit te projekteve te perbashketa me institute analoge, si dhe rritjen e nivelit mesimor e didaktik ne gjeofiziken e aplikuar.

- Teknikat gjeofizike te perdorura ne kete studim, mund te aplikohen me sukses ne shume fusha te tjera studimore, sidomos me karakter inxhinierik dhe ambjental.

- Baza e te dhenave te siguruara gjate ketij studimi, sherben per perdorim nga shkencetaret e rinj dhe studentet e nivelit te dyte apo te trete, te cilet mund te merren me zgjerimin e njohurive te tyre ne fushen e gjeofizikes se aplikuar.

5. METODOLOGJIA E PERDORUR

Fushat e aplikimit						
Teknika Rilevuese	Struktura Gjeologjike	Struktura Aktive nga ana hidraulike	Landfille/ Vend grumbullimi plehrash	Zonat e Ndotjeve	Rreshqitje/ Zhytje te tokes	Arkeologji
Gravimetri	+	o	o	-	o	o
Magnetometri	+	-	+	-	-	+
Fusha natyrore	o	+	o	o	+	-
Rezisyence+IP	+	+	+	+	+	+
Elektromagnetike	o	+	+	+	-	o
Gjeoradar	o	o	+	o	o	+
Radioaktive	o	o	o	o	o	-
Sizmika e valeve Te perthyera	+	o	o	-	o	o
Sizmika e valeve Te reflektuara	+	o	-	-	-	-
Gjeotermia	o	+	o	-	o	-

+ e aplikueshme, o e apikueshme ne menyre te kufizuar, - jo e aplikueshme

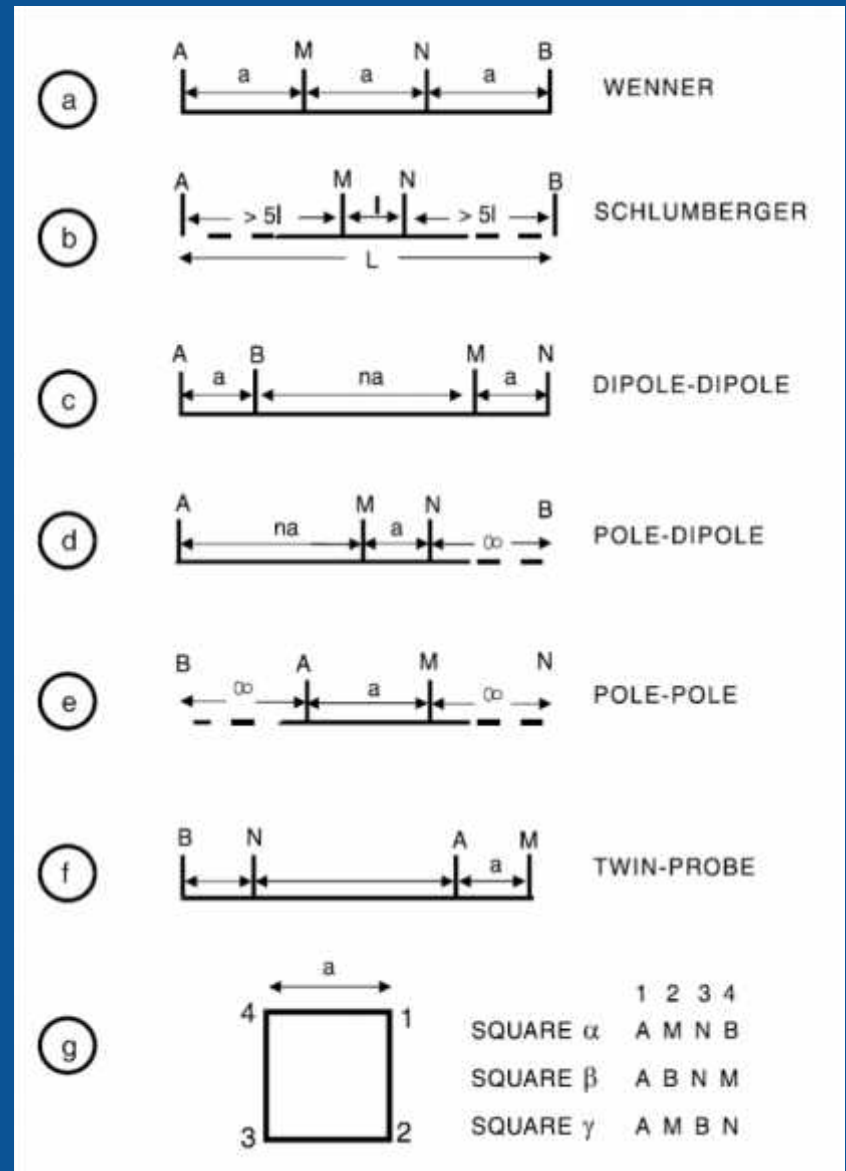
5. METODOLOGJIA E PERDORUR

Metoda gjeoelektrike e rilevimit

$$\rho_a = K(V / I)$$

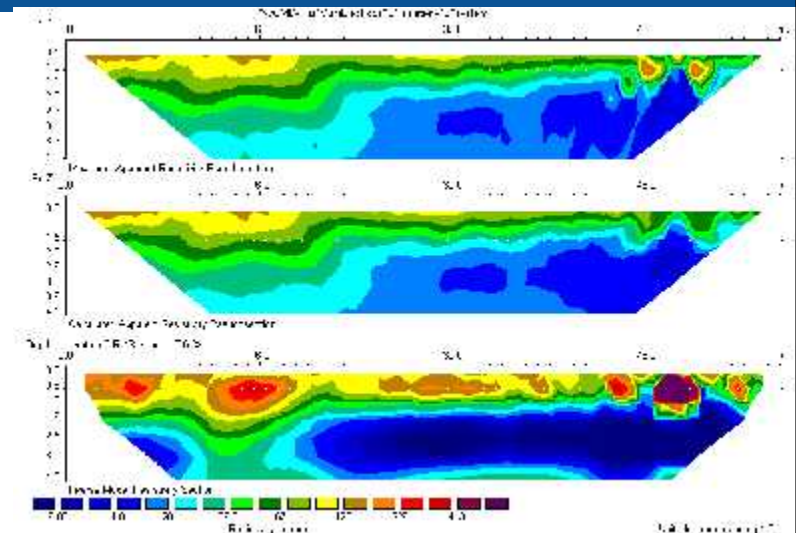
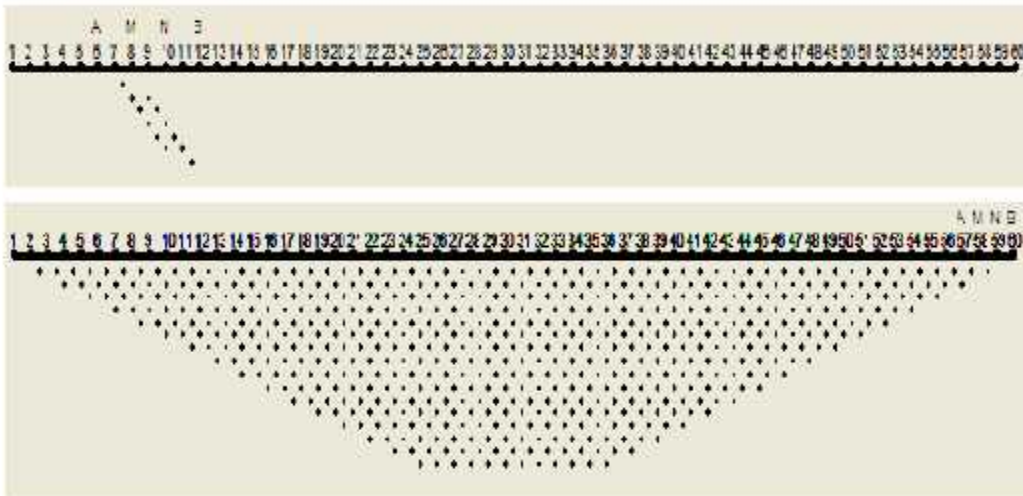
Skemat gjeofizike me te perdorshme ne rilevimet fushore:

- a) Wenner,
- b) Schlumberger,
- c) dipole -dipole,
- d) pole-dipole,
- e) pole-pole,
- f) twin-probe,
- g) square array.

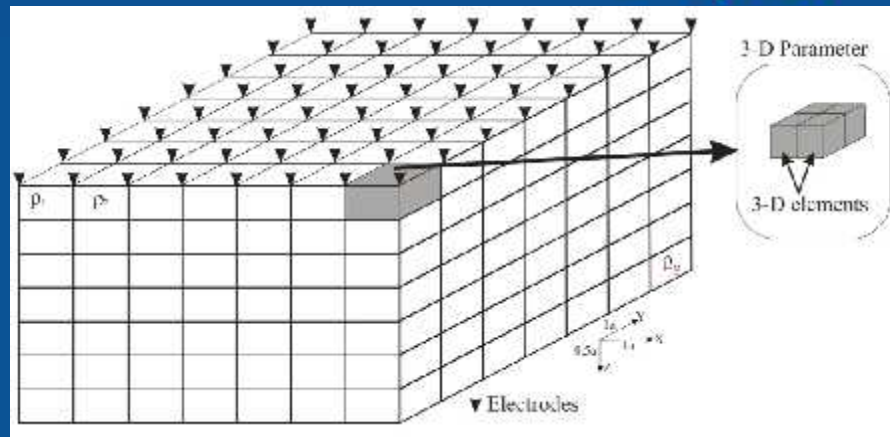


5.1 Imazhet 2D, te rezistences

1. Teknika ERT eshte nje teknike rilevuese gjeofizike me metoden e rezistences
2. Teknika 2D e rezistences ka evoluar 10 vjeçar in e fundit
3. Nje seri elektrodash shtrihet ne toke, te lidhura ndermjet tyre nepermjet nje kabulli shume-elektrodes (multicore)
4. Trajtimi i te dhenave te grumbulluara me inversionin jo-linear 2D-3D, eshte i domosdoshem.



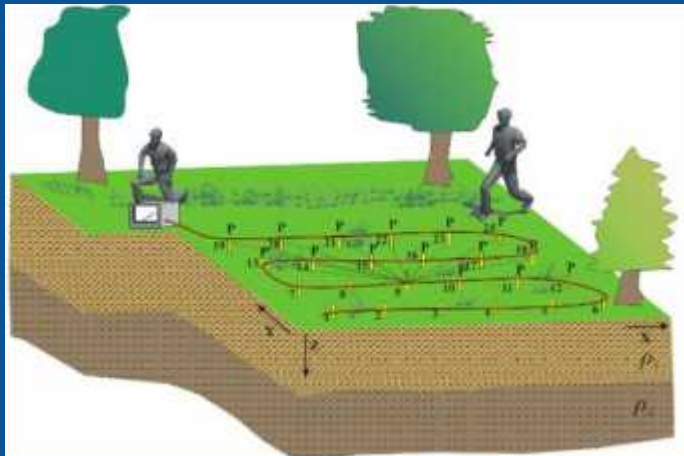
5.2 Rilevimet 3D te rezistences dhe interpretimi I tyre.



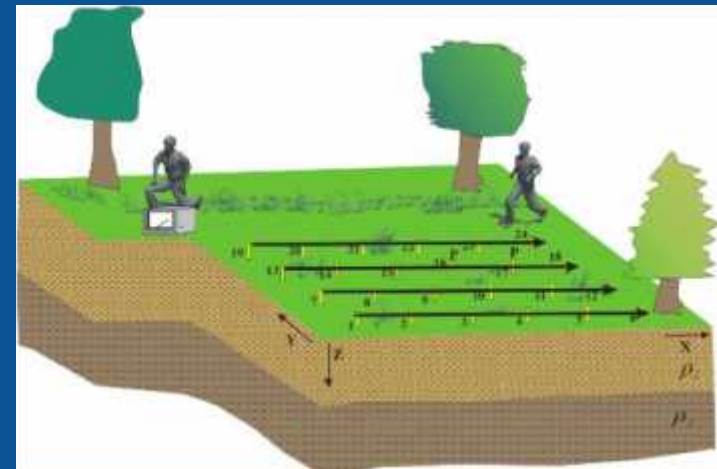
$$dy = Jdx,$$

$dy = y - F(x)$ Diference, vlera te kalkulura nga ato te vrojtuar

$$(J^T J + \lambda C^T C) dx = J^T dy \implies \text{Least Square Solution}$$



Kuadrat matjesh tre dimensional te rezistences



Rilevim 3D ne formen e linjave paralele te denduara

5.3 METODA ELEKTROMAGNETIKE (EM)

Mbeshtetet ne parimin e matjes se percjellshmerise se nentokes, nepermmjet dergimit ne toke te impulseve elektromagnetike dhe regjistrimit te fushes dytesore. (koeficienteve te reflektimit) nga nentoka

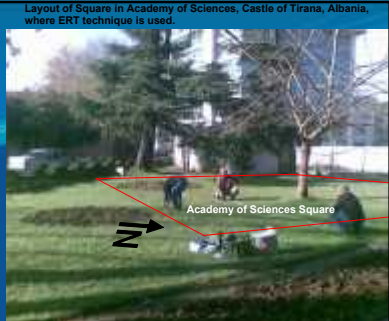
Metoda GPR (elektromagnetike) si test ne studimet arkeologjike ne Shqiperi, me ndihmen e instrumentit eXp 5000, duke perdorur si burim te sinjalit elektromagnetik antenat GPR horizontale 0.5m dhe 0.75m

5.4 METODA MAGNETOMETRIKE

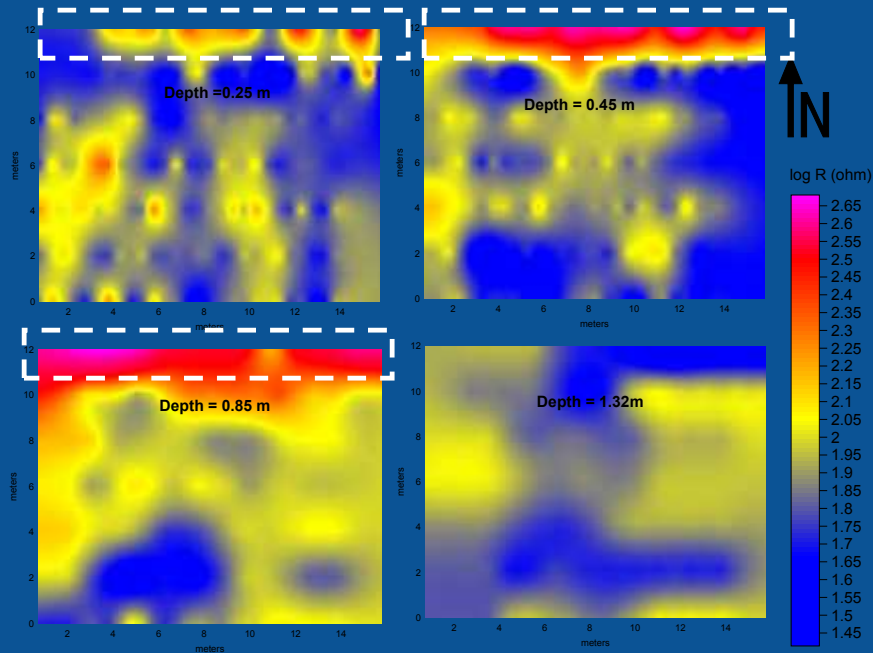
Nepermjet rilevimeve magnetometrike, maten ndryshimet e komponenteve te fushes magnetike te Tokes dhe ne kete menyre mund te dedektohen objekte me predispozitet te larte apo ulet magnetik. Eshte perdorur per here te pare ne arkeologji nga Aitken (Aitken, 1974)

6. REZULTATET E PUNIMEVE EKSPERIMENTALE TE TEKNIKES ERT

A) "Kalaja e Tiranes"

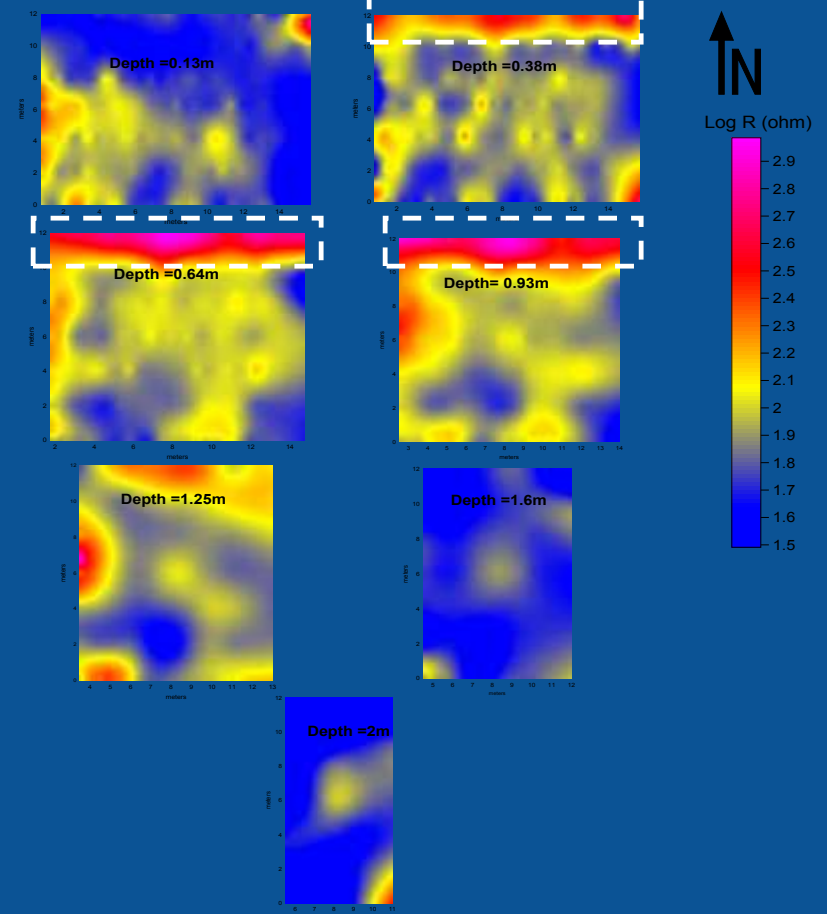


H. Reci, 2010. Images of true resistivity values in different depths in Tirana castle area, Albania. Results taken from Resistivity Tomography Profiles. Dipole-Dipole Array, 30 simultaneous electrodes used, distance between profiles 1m, distance between electrodes 0.5 m.



Skema Dipole-Dipole

H. Reci, 2010. True resistivity values images in different depths in Tirana castle area, Albania. Results taken from Resistivity Tomography Profiles. Wenner Array, 30 simultaneous electrodes used, distance between profiles 1m, distance between electrodes 0.5 m.



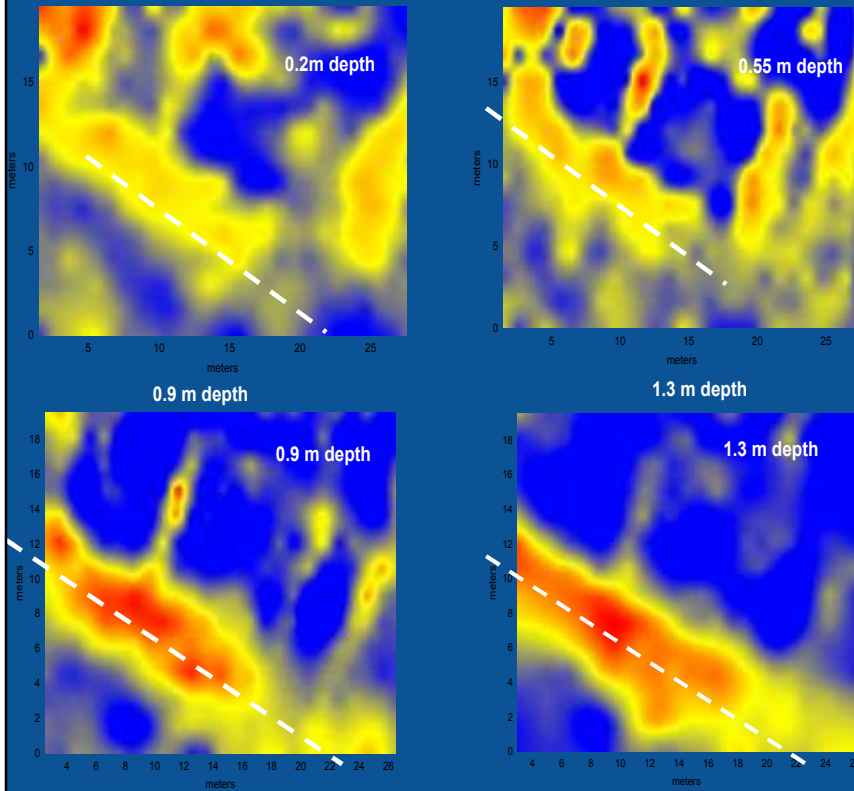
Skema Wenner

B, Kuadrati 1 "Banjo romake", Apolloni

Layout of Squares in Roman Thermal Baths, Apollonia, Albania where ERT technique is used.

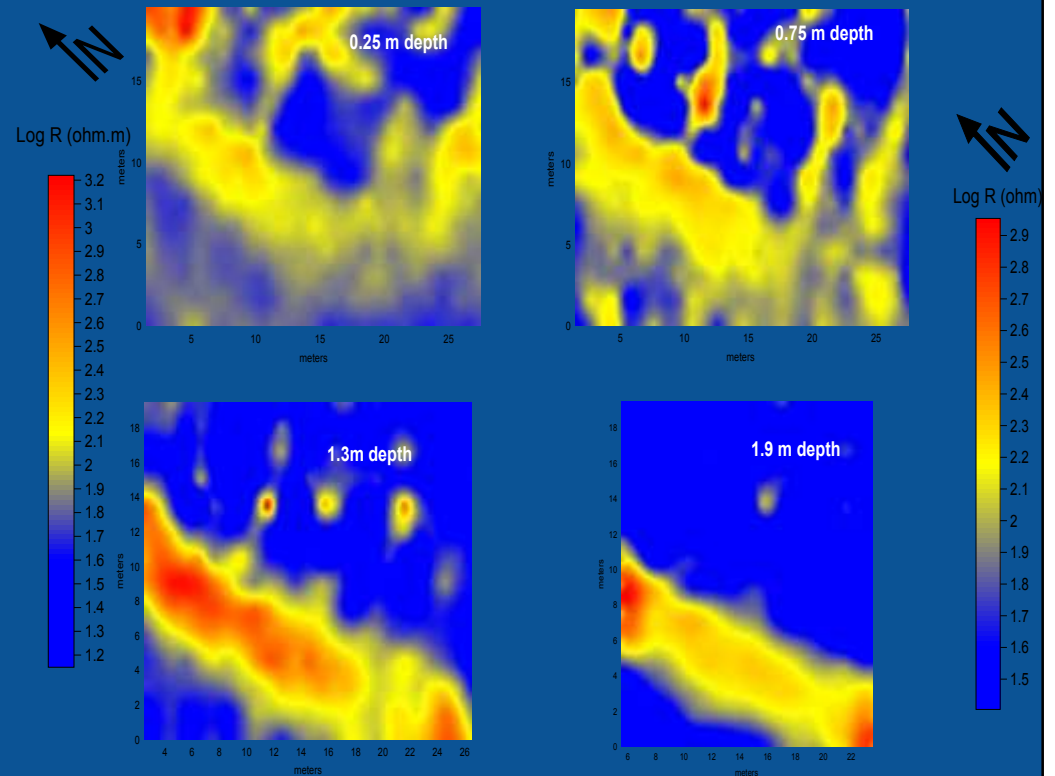


H. Reci, 2011. Images of true resistivity values in different depths in thermal baths (square 1), Apollonia, Albania. Results taken from Resistivity Tomography Profiles. Dipole-Dipole Array, 30 simultaneous electrodes used, distance between profiles 1.5m, distance between electrodes 1m.



Skema Dipole-Dipole.

H. Reci, 2011. Images of true resistivity values in different depths in thermal baths (square 1), Apollonia, Albania. Results taken from Resistivity Tomography Profiles. Wenner Array, 30 simultaneous electrodes used, distance between profiles 1.5m, distance between electrodes 1m.

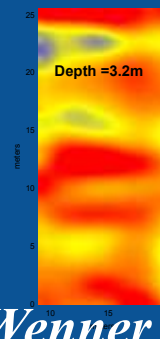
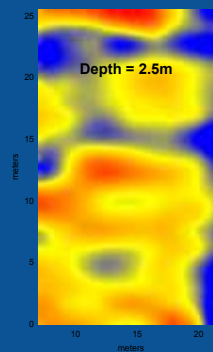
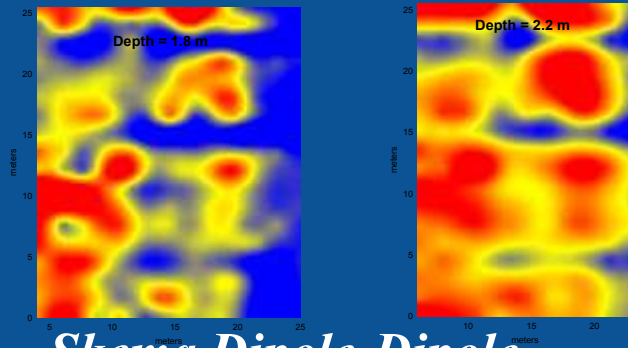
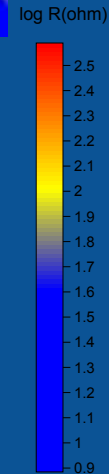
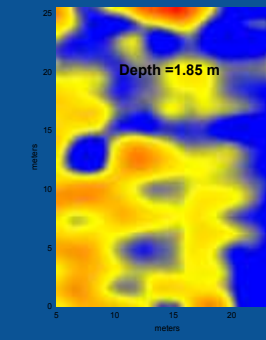
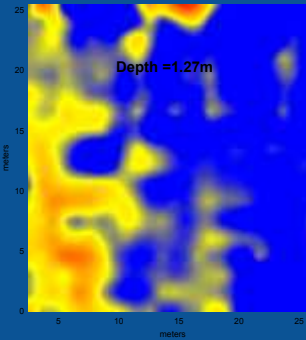
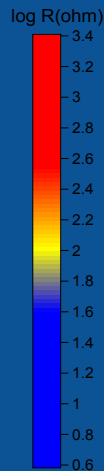
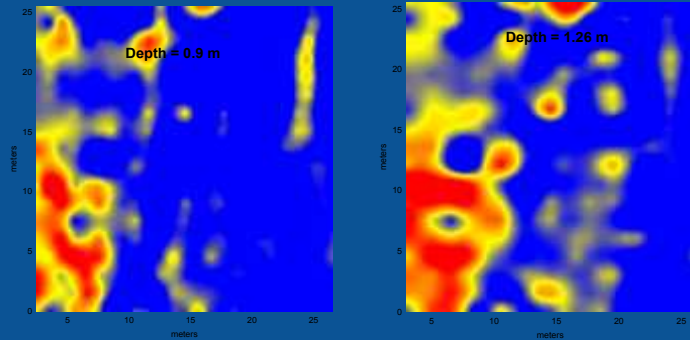
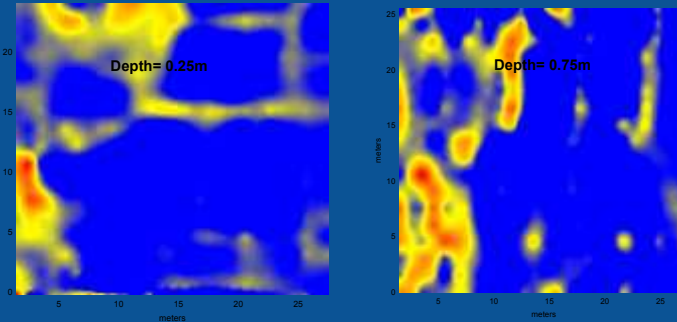
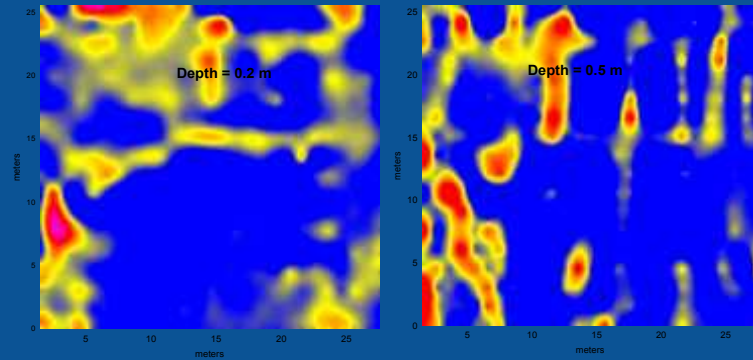
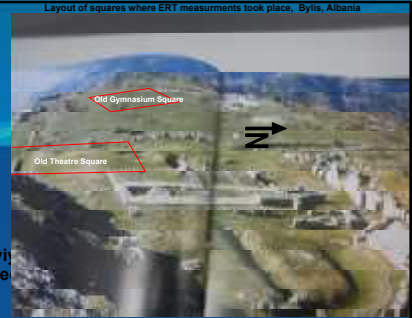


Skema Wenner

C. Bylis, Kuadrati prane Gjimnazit te vjeter

H. Reci, 2010. True resistivity values images in different depths in Old Gymnasium area, Bylis, Albania. Results taken from Resistivity Tomography Profiles. Dipole-Dipole Array, 30 simultaneous electrodes used, distance between profiles 1.5m, distance between electrodes 1m.

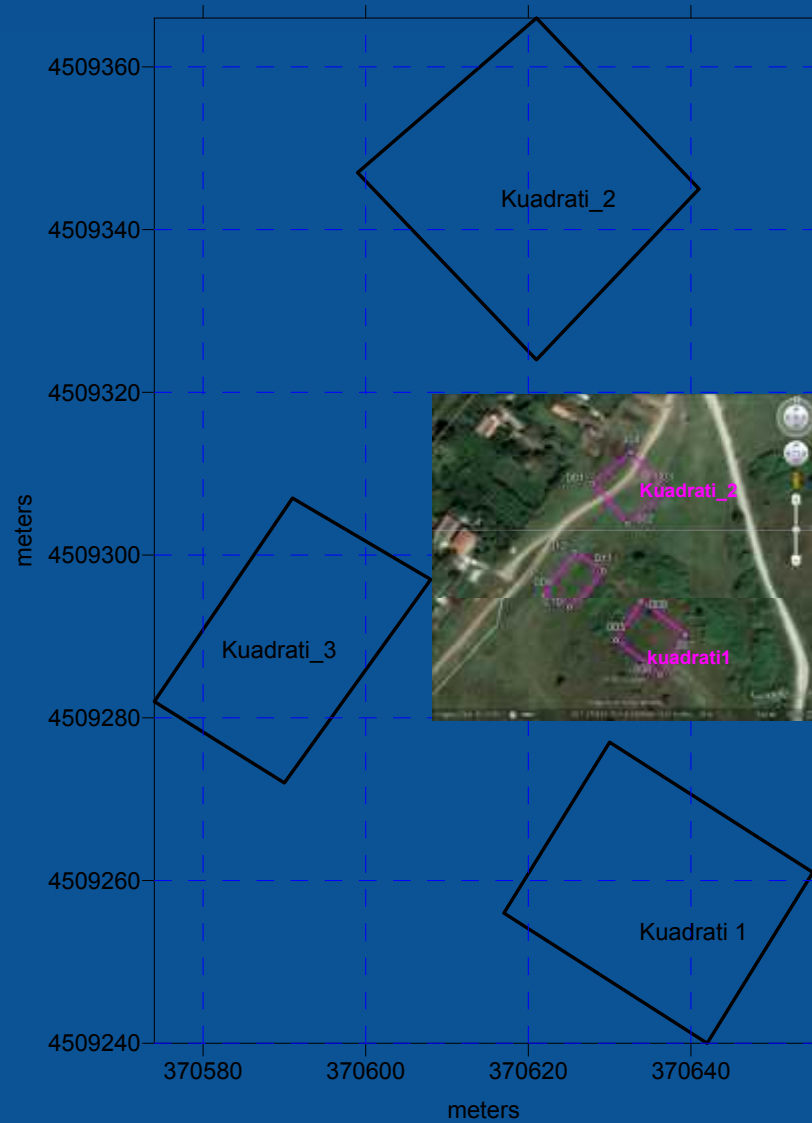
H. Reci, 2010. True resistivity values images in different depths in Old Gymnasium area, Bylis, Albania. Results taken from Resistivity Tomography Profiles. Wenner array, 30 simultaneous electrodes used, distance between profiles 1.5, distance between electrodes 1m.



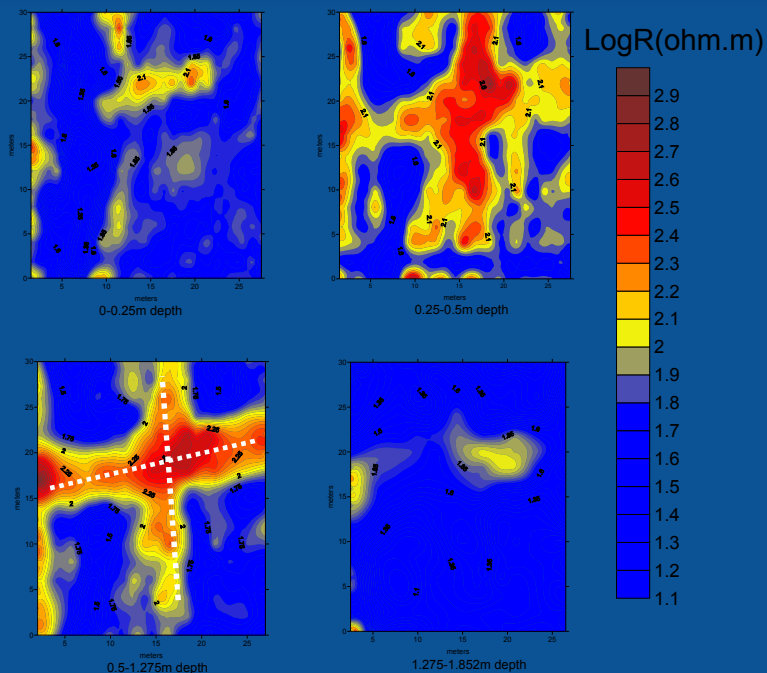
Skema Dipole-Dipole

Skema Wenner

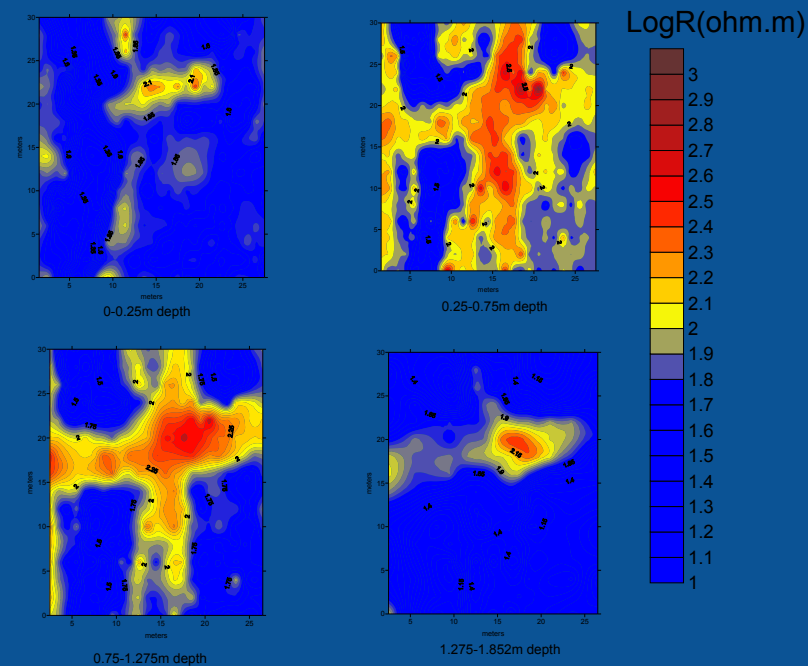
D. Veri te banjove romake, Apolloni



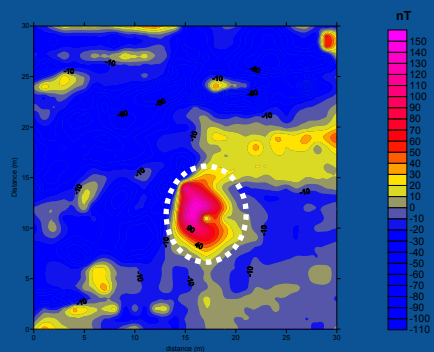
D. Kuadrati 2, Veri te banjove romake, A, B) hartat e imazheve te rezistences, C) Magnetike, D) Elektromagnetike



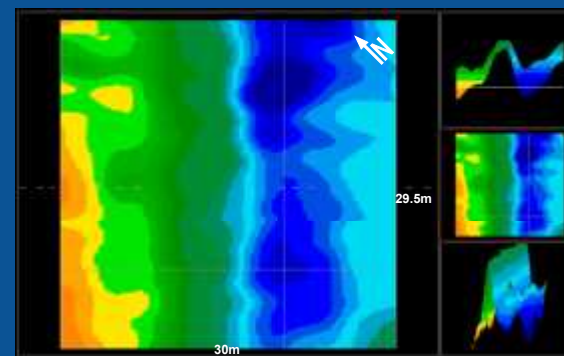
A)



B)



C)



D)

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7. FALENDERIME

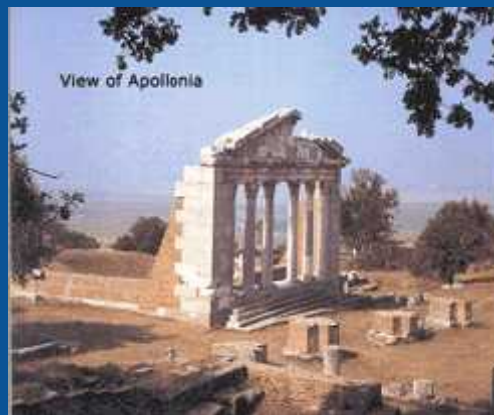
- Agjensia e Kerkimit, Teknologjise dhe Inovacionit (AKTI)- **financim ne kuadrin e PKZH.**
- Instituti i Gjeoshkencave, Energjise, Ujit dhe Mjedisit (IGJEUM, UPT)- **Projekte te brendshme**
- Akademia e Shkences per Vendet ne Zhvillim (TWAS)- **Sigurim i bazes instrumentale**
- Akademia e Shkencave te Shqiperise (A.Sh.Sh)- **bashkepunim, sigurim i bazes instrumentale**





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View of Apollonia



Layout of Square in Academy of Sciences, Castle of Tirana, Albania, where ERT technique is used.

STUDIM EMERGJENT ARKEOLOGJIK I KALASE SE TIRANES
NEPERMJET TEKNOLOGJIVE TE REJA GJEOFIZIKE TE ERT DHE
GJEORADARIT

FALEMINDERIT

PETJE????