REPUBLIC OF TURKEY
MUGLA SITKI KOCMAN UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

DEPARTMENT OF GEOLOGICAL ENGINEERING

SPATIAL DISTRIBUTION OF GEOCHEMICAL PROPERTIES OF KÖYCEĞİZ LAKE AND FETHİYE-GÖCEK BAY BOTTOM SEDIMENTS AND EFFECT OF SUBAQUEOUS GEOTHERMAL SPRINGS ON THESE PROPERTIES

MASTER OF SCIENCE THESIS

ZEYNEP ANKUT

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Z. ANKUT DEPT. OF GEOLOGICAL ENGR. MASTER THESIS MUĞLA 2017

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THESIS ACCEPTANCE CONFIRMATION

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Date of Defence: 04/05/2017

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conducts, I have fully cited and referenced all materials and results that are not original to this work.

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04/05/2017

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ÖZET

KÖYCEĞİZ GÖLÜ VE FETHİYE-GÖCEK TABANINDAKİ ÇÖKELLERİNİN JEOKİMYASAL ÖZELLİKLERİNİN ALANSAL DAĞILIMI VE SUALTI JEOTERMAL KAYNAKLARIN BU ÖZELLİKLERE ETKİSİ

Zeynep Ankut

Yüksek Lisans Tezi

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Jeoloji Mühendisliği Anabilim Dalı

Danışman: Yrd. Doç. Dr. Özgür AVŞAR

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Köyceğiz gölü, güneybatı Anadolu'da Muğla il sınırları içinde yer almaktadır. Sultaniye ve Köyceğiz havzası olmak üzere iki havzadan oluşan göl, Dalyan kanalı ile Akdeniz'e bağlanmaktadır. Fethiye–Göcek Körfezi ise Köyceğiz gölünün güneybatısında yer almaktadır. 112Y137 numaralı Tubitak Projesi kapsamında, Köyceğiz gölünde 3, Fethiye-Göcek körfezinde 1 adet sualtı sıcak su kaynağı tespit edilmiştir. Ayrıca, Köyceğiz gölünde 2 adet sualtı soğuk su kaynağı bulunmuştur. Bu sualtı sıcak ve soğuk su kaynaklarının göl ve deniz tabanındaki sedimanlara etkisi bu tez kapsamında araştırılmıştır. Bu sebeple göl ve deniz tabanından gravite yöntemi ile toplamda 204 adet karot alınmıştır. Alınan karotların üst kısımlarından 5'er cm alınarak yapay karotlar oluşturulmuştur. Yapay karotlar, Bremen Üniversitesi'nde ITRAX marka micro-XRF cihazı ile analiz edilmiştir. Yapılan analiz çalışmaları sonucunda, Köyceğiz gölünde, sualtı sıcak su kaynakları çevresinde Cl, Br, S elementlerinin değerlerinde alansal olarak artış gözlenirken, Fethiye-Göcek körfezinde ise sualtı sıcak su kaynağı çevresinde alansal olarak artan Sr, Ca, Cl ve S değerleri saptanmıştır.

Bu çalışma TÜBİTAK'ın 112Y137 no'lu projesi ve TÜBİTAK – 2210-C 2016 Öncelikli Alanlara Yönelik Yurt İçi Yüksek Lisans Burs Programı tarafından desteklenmiştir.

Anahtar Kelimeler: ITRAX, Micro-XRF, Batı Anadolu

ABSTRACT

SPATIAL DISTRIBUTION OF GEOCHEMICAL PROPERTIES OF KÖYCEĞİZ LAKE AND FETHİYE GÖCEK BAY BOTTOM SEDIMENTS AND EFFECT OF SUBAQUEOUS GEOTHERMAL SPRINGS ON THESE PROPERTIES

Zeynep Ankut

Master of Science (M.Sc.)

Graduate School of Natural and Applied Sciences

Department of Geological Engineering

Supervisor: Asst. Prof. Dr. Özgür AVŞAR

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Köyceğiz Lake is located in Muğla Provience, Southwest of Turkey. There are two basins in the lake: Köyceğiz basin in the north and Sultaniye basin in the south. The lake is connected to Mediterranean Sea with Dalyan channel. There are three hot spings were found in Köyceğiz Lake and one hot spring was found in Fethiye-Göcek Bay. In addition, two cold springs were found in Köyceğiz Lake in the scope of Tubitak Project number 112Y137. In this thesis, effects of sub-aqueous hot springs to the bottom sediments were explored. For that purpose, 204 gravity cores were taken from the bottom of lake and sea. Artificial cores were created by taking 5 cm of sediments from the top of the cores. These artificial cores were analyzed by ITRAX-micro-XRF core scanner in Bremen University. As a result of this analysis, around subaqueous hot springs, high anomaly in Cl, Br, and S elements were detected in the bottom sediments of Köyceğiz Lake. Positive anomaly was recorded in Sr, Ca, Cl and S elements around subaqueous hot spring in Fethiye-Göcek Bay sediments.

This thesis is supported by TUBITAK Project with the number 112Y137 and TUBITAK–2210-C 2016 Öncelikli Alanlara Yönelik Yurt İçi Yüksek Lisans Burs Programı.

Keywords: ITRAX, Micro XRF, Western Anatolia

To people looking at our eyes while talking

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My special thanks to my family. I also dedicate this thesis to my father and my mother.
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1. INTRODUCTION

1.1 Aim and Scope

The aim of this study is determining the spatial distribution of geochemical properties of bottom sediments of Köyceğiz Lake and Fethiye - Göcek Bay. Determining the effect of subaqueous geothermal springs on these properties is another aim. As a result of the project that is supported by TUBITAK Project (112Y137) three subaqueous hot springs were found in Köyceğiz Lake and one subaqueous hot spring was founded in Fethiye - Göcek Bay. Are these bottom sediments effected by subaqueous hot springs? This question is the focus of this thesis. After this opinion, there are 99 gravity cores were recovered from Fethiye-Göcek Bay, 105 gravity cores were recovered from Köyceğiz Lake by using investigation platform and by using a gravity corer. By taking 50 mm sample from the top of the core samples and by adding them to each other, artificial u-channels were prepared in the Muğla Sıtkı Koçman University (MSKU) Hydrogeology Laboratory. These artificial cores were sent to Bremen University for ITRAX X-Ray Fluorescence analysis. The measurements were taken every 2 mm and in every 10 seconds on these artificial cores and 25 elements were counted semi quantitatively.

In the light of data gathered from the analyses, iso-concentration maps of the elements were prepared and spatial distribution of the elements in the lake sediments was investigated.

1.2 Study Area

Köycegiz Lake and Fethiye Göcek Bay, are located in Muğla province in the southwest of Turkey (Figure 1.). Köyceğiz Lake has different features according to their geographical location and geological structure as compared to other lakes. The lake is

fed by the Namnamçay and Yuvarlakçay rivers, meteoric water and alluvial groundwater (Bayarı et al., 1995) and discharged to the Mediterranean Sea by the Dalyan Channel. The Fethiye-Göcek Bay is a transitional zones between zones the Aegean Sea and Mediterranean Sea.

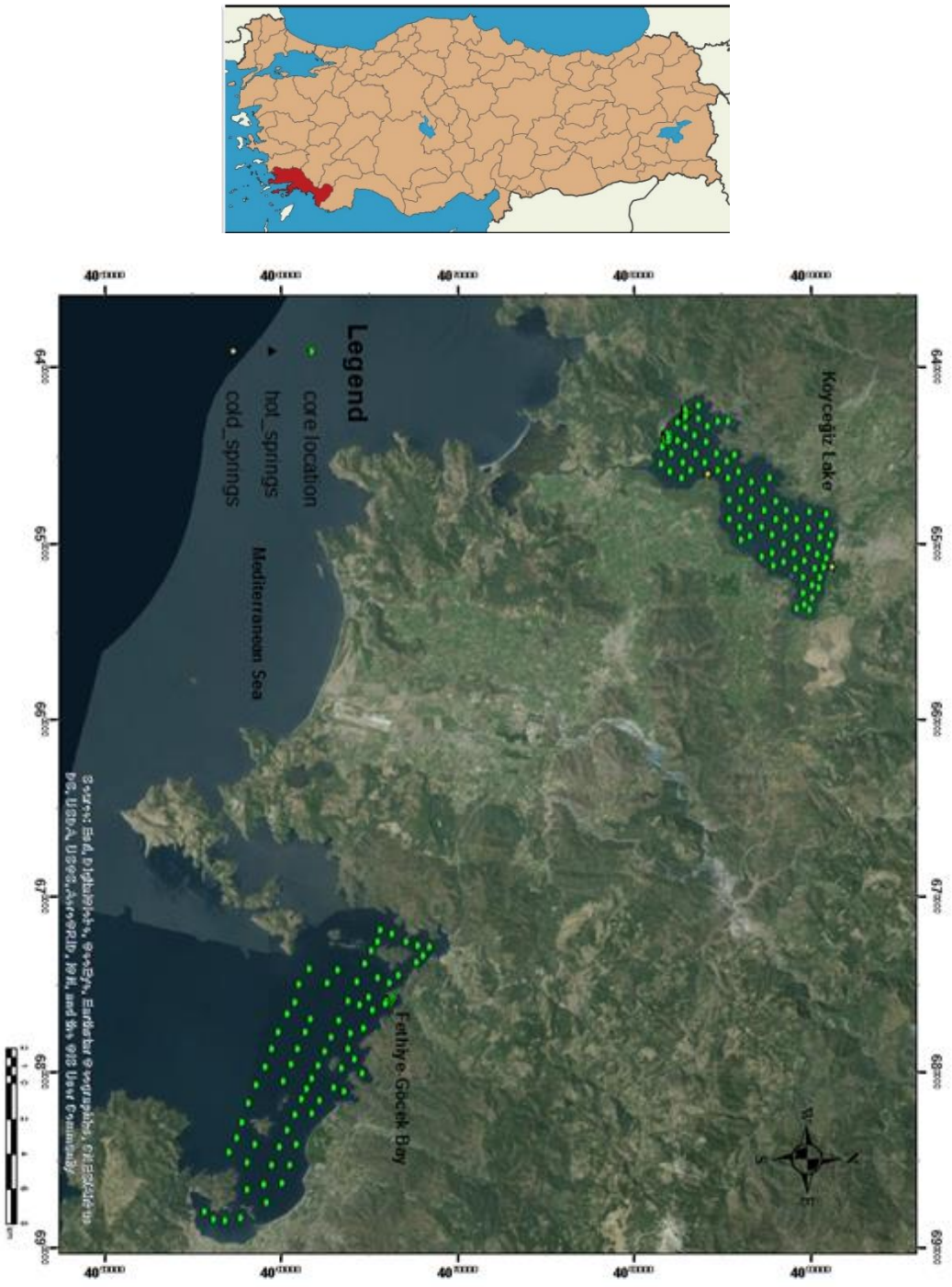

Figure 1.1. Location map of Köyceğiz Lake and Fethiye-Göcek Bay and the cores sampling locations.

1.3 Geography of the Region

Köyceğiz Lake has a 55 km^2 surface area. It is about 7 m above the sea level. The deepest point of the lake is 32 m (Bayarı ve Kurttaş, 2000). Köyceğiz-Dalyan Lagoon Basin, has an area of approximately 1200 km^2 and the sub-basin that constitutes the Dalyan is approximately 130 km^2. There are two drainage areas in the region. First drainage area occurs around Köyceğiz Lake, and a second one occurs around Dalyan Channel Network, Alagöl, Sülüngür Lake ve İztuzu Lake (İkiel, 1997). The Dalaman, Sarısu, Tersakan, Namnamçay and Yuvarlakçay rivers are the major surface waters in the study area. According to the lake water balance equation, the outflow is higher than the amount of inflow (Eraslan, 1991; Tansuğ and Öztunalı, 1976). Bayarı et al. (1995) argues that this amount of water must be supplied by the hot/cold subaqueous springs. There are many permanent and seasonal streams around the Fethiye - Göcek Bay. Çayboğazı River, Değirmenboğazı River, Sinekli River, Çerçi River, Üzümlü River are major surface water.

1.4 Geological Setting

The Köyceğiz Lake and Fethiye-Göcek Bay are at the western end of the Taurus tectonic belt (Graciansky, 1968; 1972). According to previous studies the geological structure is composed of three different rock units, which are autochthonous carbonates, allochthonous Lycian Nappes, and the ophiolite nappe. Plio-quaternary aged post-orogenic sediments overlay these units (Şenel, 1997). The study area includes geological formations which are Beydağları Autochthonous, Yeşilbarak Nappe and overlay the Tavas nappe, Bodrum Nappe, Marmaris Ophiolite Nappe and Gülbahar Nappe (Şenel, 1997). Beydağları autochthonous is the main geological units in the study area (Şenel, 1997). Yeşilbarak Nappe is the transition zone which is between Beydağları autochthonous and Lycian Nappes (Şenel et al., 1987).

The results of enclosed of neotethys ocean, there is a compression along the S-N direction through the İzmir- Ankara- Erzincan Suture Zone. This occurrence is

continued from Eocene to Pliocene. The end of the Pliocene, lots of normal faults are consists (Şenel, 1997).

Lycian Nappes includes, Paleozoic and early Mesozoic carbonates, volcano-sediments and Cretaceous ophiolite and late cretaceous sedimentary rocks (Özgül, 1976). Lycian nappes are consists of four nappes. These nappes are Tavas nappe, made up of Carboniferous Lutetian rock units, which are limestone, dolomite, dolomitic limestone, sandstone, shale, conglomerate, claystone, radiolarite, spilite, basalt; Bodrum nappe, consisting of Upper Triassic–Upper Senonian aged units, which are limestone, dolomite, dolomitic limestone, flysch, serpentinite, radiolarite, basalt; Gülbahar nappe, composed of Middle Triassic–Upper Senonian rock units, which are limestone, dolomite, basalt, radiolarite, chert, shale; and Marmaris nappe, consisting of Lower Cretaceous ultramafic rock units, which are harzburgite, dunite, serpentinite, diabase, gabbro and amphibolite. Neo-autochthonous units cover all of the underlying formations. These units are composed of Pliocene lacustrine claystone, marl, sandstone, and Quaternary alluvium, beach sediments, alluvial fan, slope debris and fluvial terraces (Gökgöz, 2006).

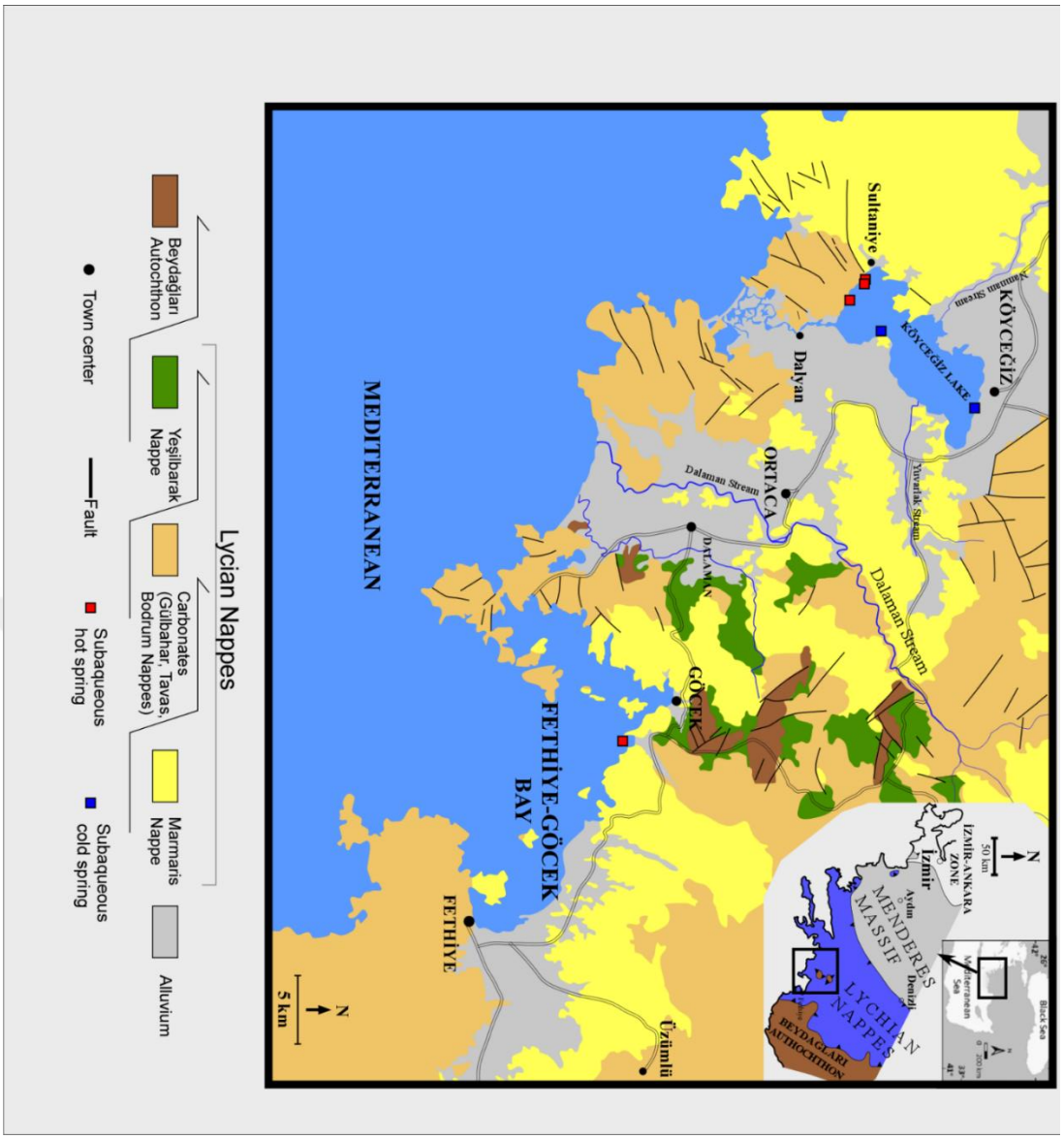

Figure 1.2. Geological map of the study area (modified and simplified from Şenel 1997a and Şenel 1997b).

Köyceğiz Lake and Fethiye - Göcek Bay stands at the south of the E-W trending tectonic line that extends along Bodrum to Fethiye (Doğu, 1988). The present morphology of the basin was formed as a consequence of the vertical tectonic activities. As a result of the vertical tectonic movements, a number of normal faults trending NE-SW and horst- graben structures throughout the basin are formed. During the Pliocene, grabens, which form the Köyceğiz and Dalaman Plains, were filled with marl, conglomerate and limestone geological units (Figure 1.2.). The Köyceğiz Lake starts form during the Plio-Quaternary time as a result of the closing of the channel between the lake and the sea (Bayarı, 1994). In the region, Lake Köyceğiz mostly surrounded by Quartenary alluvium and Upper Cretaceous ophiolite mélange. On the south of the lake sedimentary units (Jurassic- Cretaceous pelagic limestones, clastic carbonates) are observed. The Namnamçay River flows within the ophiolite melange of the Marmaris Nappe and its flow is negligible during summer. The lake is fed by the Namnamcay and Yuvarlakcay rivers, rain and alluvial groundwater (Bayarı et al., 1995) and discharged to the Mediterranean Sea by the Dalyan Channel. (Yeşertener, 1986; Bayarı et al., 1995).

The previous hydrogeologic studies (Tansuğ and Öztunalı, 1976; Yeşertener, 1986; Eraslan, 1991) state that there are a number of karstic and thermal springs at the bottom of the lake. The origin of the lake water has not been determined yet. There are two basins in the Lake Köyceğiz. The Sultaniye Basin's depth is -24m and the Köyceğiz Basin is -32m depth. There is a ridge in the middle of two basins which is called "Gedova Boğazı". This ridge is "imaginary" which lies along between the west part of the Yoğun Edge and east part of the Gedova Hill (Bayarı, 2000). The annual mean temperature of the Lake is 13°C - 14°C. The temperature changes are not different between the Sultaniye Basin and Köyceğiz Basin on the upper part of the Lake. These basins have very different temperatures at the bottom of the Lake. Sultaniye Basin has higher temperature than the Köyceğiz Basin. The pH is approximately 8.6 in two basins (Bayarı, 2000).

2. METHODOLOGY

Three hot springs in Köyceğiz Lake and one hot spring in Fethiye-Göcek Bay were found in Tubitak Project (number 112Y137). In this thesis, to determine the effects of sub-aqueous hot springs to bottom sediments, 204 gravity cores were taken from bottom sediments of Lake and Sea. There are 99 gravity cores were taken from Fethiye-Göcek Bay, 105 gravity cores were taken from Köyceğiz Lake (Fig 2.3.). The cores were taken by using an investigation platform which was designed within the scope of Tubitak Project (Figure 2.1.).

Figure 2.1. Core recovery by a portable platform.

Before sending the cores to the laboratory they were saved in a refrigerator in MSKU Hydrogeology Laboratory at +4 ℃ (Fig 2.2.).

Figure 2.2. Core samples.

Location of cores were determined systematically for understanding the spatial distribution of elements (Figure 2.3, Figure 2.4.).

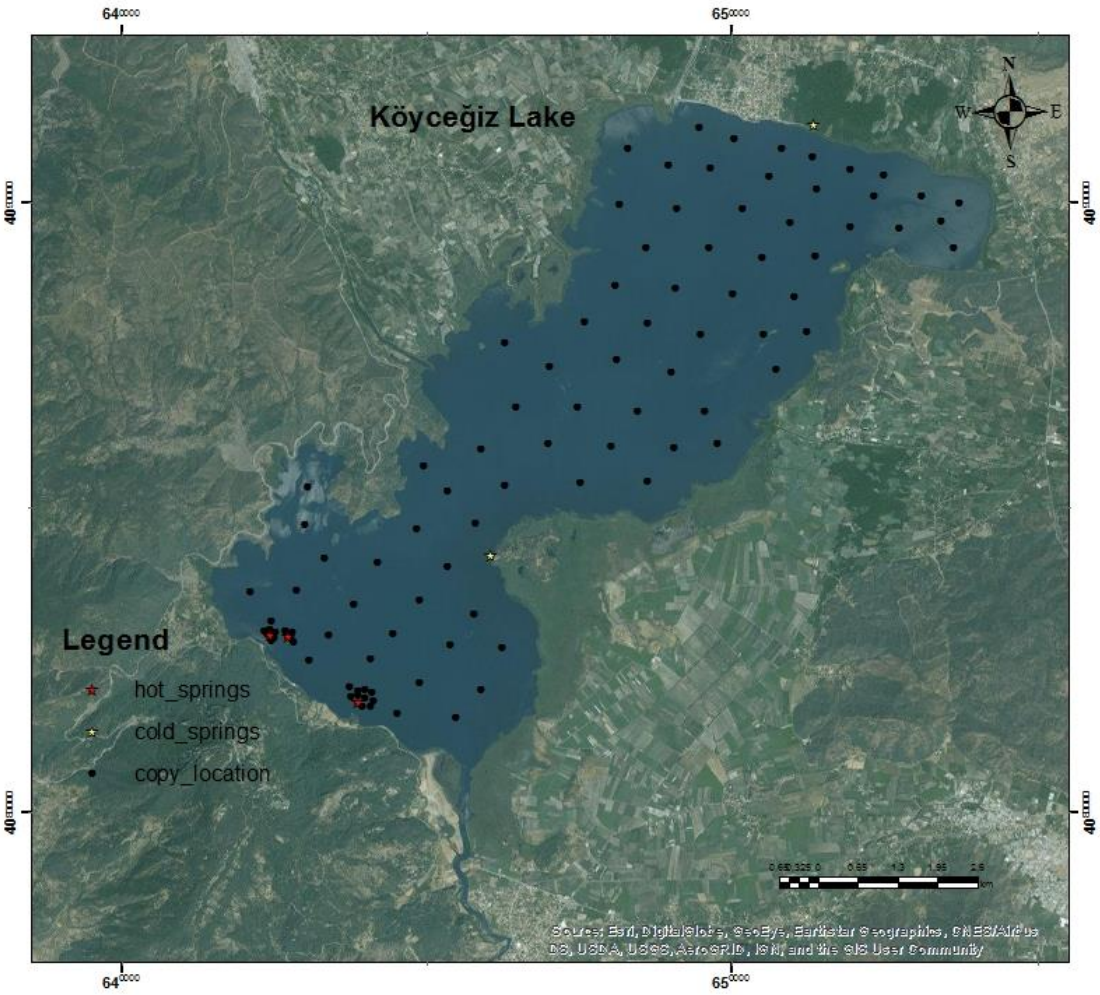

Figure 2.3. Core sampling locations in Köyceğiz Lake.

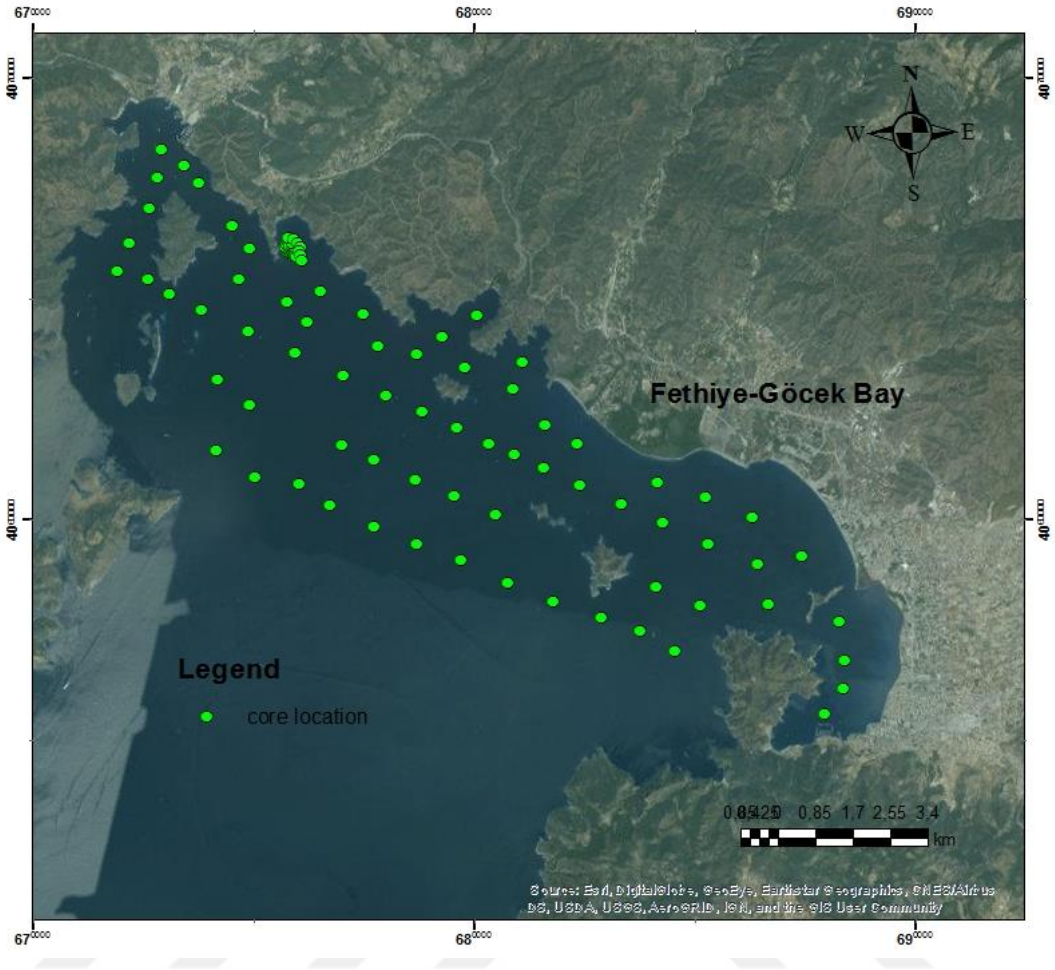

Figure 2.4. Core sampling locations in Fethiye-Göcek Bay

Top 5 cm from the cores were sampled with the help of syringe. The sampled soil was put in PVC half pipes. By putting 2 cm diameter soil samples in the PVC pipes successively, artificial cores were prepared (Fig 2.3.). Ten artificial cores were prepared. These artificial cores were containing 20-27 locations. These artificial cores were covered transparent bag for preventing of drying (Figure 2.3.). Length of each gravity core was measured and recorded. Then, artificial cores were sent Bremen University for ITRAX micro-XRF analysis.

Figure 2.5. Forming of artificial cores.

Locations of cores were designed systematically in order to delineate the elemental anomalies both throughout the area and around the hot/cold springs. The cores were taken regularly all over the water body (Köyceğiz lake and Fethiye-Göcek Bay). But number of core samples are increased around hot springs in order to get more precise data.

Table 2.1. Core names and locations

Coordinates UTM/WGS 84									
	Hole ID	**Easting**	**Northing**	**Location**		**Hole ID**	**Easting**	**Northing**	**Location**
1	K-9	642097	4083621	Köyceğiz Lake	**33**	K-7	642862	4083653	Köyceğiz Lake
2	K-40	642452	4083142	Köyceğiz Lake	**34**	K-38	643387	4082903	Köyceğiz Lake
3	K-015-648	642433	4082872	Köyceğiz Lake	**35**	K-36	644081	4082513	Köyceğiz Lake
4	K-015-647	642325	4082985	Köyceğiz Lake	**36**	K-43	644872	4082142	Köyceğiz Lake
5	K-015-646	642370	4082945	Köyceğiz Lake	**37**	K-66	645460	4081551	Köyceğiz Lake
6	K-015-645	642428	4083010	Köyceğiz Lake	**38**	K-65	645875	4082013	Köyceğiz Lake
7	K-015-644	642424	4082965	Köyceğiz Lake	**39**	K-44	645379	4082750	Köyceğiz Lake
8	K-015-643	642514	4082948	Köyceğiz Lake	**40**	K-35	644430	4082925	Köyceğiz Lake
9	K-015-642	642461	4082929	Köyceğiz Lake	**41**	K-10	643798	4083413	Köyceğiz Lake
10	K-015-641	642446	4082822	Köyceğiz Lake	**42**	K-6	643321	4084181	Köyceğiz Lake
11	K-015-639	642450	4082891	Köyceğiz Lake	**43**	K-41	642996	4084726	Köyceğiz Lake
12	K-015-638	642491	4082865	Köyceğiz Lake	**44**	K-8	643029	4085344	Köyceğiz Lake
13	K-015-000	642409	4082916	Köyceğiz Lake	**45**	K-11	644188	4084101	Köyceğiz Lake
14	K-T-3-635	642694	4082932	Köyceğiz Lake	**46**	K-34	644873	4083484	Köyceğiz Lake
15	K-T-3-634	642663	4082973	Köyceğiz Lake	**47**	K-45	645775	4083244	Köyceğiz Lake
16	K-T-3-633	642804	4082807	Köyceğiz Lake	**48**	K-64	646220	4082702	Köyceğiz Lake
17	K-T-3-632	642764	4082855	Köyceğiz Lake	**49**	K-33	645333	4084028	Köyceğiz Lake
18	K-T-3-631	642795	4082968	Köyceğiz Lake	**50**	K-12	644828	4084650	Köyceğiz Lake
19	K-T-3-630	642763	4082920	Köyceğiz Lake	**51**	K-32	645786	4084749	Köyceğiz Lake
20	K-T-3-000	642725	4082889	Köyceğiz Lake	**52**	K-13	645320	4085261	Köyceğiz Lake
21	K-39	643071	4082508	Köyceğiz Lake	**53**	K-5	644934	4085676	Köyceğiz Lake
22	K-37	643718	4082070	Köyceğiz Lake	**54**	K-14	645876	4085956	Köyceğiz Lake
23	K-R-621Y	643940	4081750	Köyceğiz Lake	**55**	K-31	646267	4085354	Köyceğiz Lake
24	K-R-620	643987	4082011	Köyceğiz Lake	**56**	K-46	647507	4085404	Köyceğiz Lake
25	K-R-619	643861	4081923	Köyceğiz Lake	**57**	K-30	646970	4086044	Köyceğiz Lake
26	K-R-618	644120	4081843	Köyceğiz Lake	**58**	K-15	646450	4086636	Köyceğiz Lake
27	K-R-617	644065	4081747	Köyceğiz Lake	**59**	K-3	646262	4087710	Köyceğiz Lake
28	K-R-028	643751	4081904	Köyceğiz Lake	**60**	K-16	646992	4087300	Köyceğiz Lake
29	K-R-027	643975	4081886	Köyceğiz Lake	**61**	K-29	647464	4086657	Köyceğiz Lake
30	K-R-026	644100	4081976	Köyceğiz Lake	**62**	K-47	648001	4086000	Köyceğiz Lake
31	K-R-024	643871	4082002	Köyceğiz Lake	**63**	K-63	648601	4085443	Köyceğiz Lake
32	K-42	644494	4081634	Köyceğiz Lake	**64**	K-62	649048	4085973	Köyceğiz Lake

Table 2.1 Core names and locations is continued.

Coordinates UTM/WGS 84									
	Hole ID	**Easting**	**Northing**	**Location**		**Hole ID**	**Easting**	**Northing**	**Location**
65	K-48	648447	4086580	Köyceğiz Lake	**20**	I-121	675987	4066125	Inlice
66	K-67	649761	4086044	Köyceğiz Lake	**21**	I-113	675938	4066182	Inlice
67	K-61	649544	4086587	Köyceğiz Lake	**22**	I-116	675869	4066262	Inlice
68	K-49	648992	4087228	Köyceğiz Lake	**23**	I-133	675774	4066397	Inlice
69	K-28	648103	4087422	Köyceğiz Lake	**24**	I-132	675906	4066352	Inlice
70	K-17	647583	4088032	Köyceğiz Lake	**25**	I-131	675971	4066261	Inlice
71	K-18	648079	4088632	Köyceğiz Lake	**26**	I-130	676045	4066186	Inlice
72	K-27	648616	4088021	Köyceğiz Lake	**27**	I-129	676008	4066072	Inlice
73	K-50	649472	4087826	Köyceğiz Lake	**28**	I-128	676052	4065986	Inlice
74	K-68	650723	4087255	Köyceğiz Lake	**29**	F-70	672579	4065446	Fethiye-Göcek Bay
75	K-59	650504	4087831	Köyceğiz Lake	**30**	F-63	673395	4068021	Fethiye-Göcek Bay
76	K-51	650001	4088492	Köyceğiz Lake	**31**	F-64	672902	4068383	Fethiye-Göcek Bay
77	K-26	649064	4088587	Köyceğiz Lake	**32**	F-65	672794	4067762	Fethiye-Göcek Bay
78	K-19	648575	4089249	Köyceğiz Lake	**33**	F-66	672606	4067052	Fethiye-Göcek Bay
79	K-2	648150	4089979	Köyceğiz Lake	**34**	F-67	672154	4066275	Fethiye-Göcek Bay
80	K-20	649088	4089900	Köyceğiz Lake	**35**	F-69	671900	4065635	Fethiye-Göcek Bay
81	K-25	649609	4089254	Köyceğiz Lake	**36**	F-85	673753	4067631	Fethiye-Göcek Bay
82	K-52	650482	4089108	Köyceğiz Lake	**37**	F-62	674501	4066666	Fethiye-Göcek Bay
83	K-58	651018	4088464	Köyceğiz Lake	**38**	F-84	674888	4066139	Fethiye-Göcek Bay
84	K-69	651220	4087886	Köyceğiz Lake	**39**	F-61	676075	4065876	Fethiye-Göcek Bay
85	K-57	651356	4089125	Köyceğiz Lake	**40**	F-60	674636	4065442	Fethiye-Göcek Bay
86	K-24	650173	4089890	Köyceğiz Lake	**41**	F-71	673064	4065097	Fethiye-Göcek Bay
87	K-53	650932	4089676	Köyceğiz Lake	**42**	F-59	673793	4064755	Fethiye-Göcek Bay
88	K-56	651919	4089598	Köyceğiz Lake	**43**	F-55	674162	4063171	Fethiye-Göcek Bay
89	K-70	652739	4089574	Köyceğiz Lake	**44**	F-54	674871	4064254	Fethiye-Göcek Bay
90	K-74	653614	4089248	Köyceğiz Lake	**45**	F-53	675750	4064933	Fethiye-Göcek Bay
91	K-73	653410	4089703	Köyceğiz Lake	**46**	F-83	676498	4065157	Fethiye-Göcek Bay
92	K-55	652306	4090116	Köyceğiz Lake	**47**	F-52	676183	4064459	Fethiye-Göcek Bay
93	K-54	651381	4090220	Köyceğiz Lake	**48**	F-51	675922	4063775	Fethiye-Göcek Bay
94	K-23	650589	4090434	Köyceğiz Lake	**49**	F-50	674894	4062595	Fethiye-Göcek Bay
95	K-21	649632	4090562	Köyceğiz Lake	**50**	F-49	674129	4061555	Fethiye-Göcek Bay
96	K-1	648955	4090607	Köyceğiz Lake	**51**	F-48	675028	4060955	Fethiye-Göcek Bay
97	K-22	648280	4090888	Köyceğiz Lake	**52**	F-46	677029	4063255	Fethiye-Göcek Bay
5	I-122	675744	4066234	Inlice	**85**	F-15	684122	4060834	Fethiye-Göcek Bay
6	I-107	675770	4066297	Inlice	**86**	F-14	685241	4060507	Fethiye-Göcek Bay
7	I-111	675811	4066096	Inlice	**87**	F-13	685292	4059431	Fethiye-Göcek Bay
8	I-126	675848	4066058	Inlice	**88**	F-12	684102	4058485	Fethiye-Göcek Bay
9	I-114	675878	4066055	Inlice	**89**	F-11	683750	4057461	Fethiye-Göcek Bay
10	I-125	675868	4066089	Inlice	**90**	F-10	684523	4057009	Fethiye-Göcek Bay
11	I-112	675863	4066127	Inlice	**91**	F-9	685095	4058061	Fethiye-Göcek Bay
12	I-124	675826	4066143	Inlice	**92**	F-8	686399	4058994	Fethiye-Göcek Bay
13	I-115	675794	4066195	Inlice	**93**	F-7	686293	4060059	Fethiye-Göcek Bay
14	I-120	675849	4066189	Inlice	**94**	F-6	686644	4058081	Fethiye-Göcek Bay
15	I-109	675925	4066101	Inlice	**95**	F-5	687413	4059172	Fethiye-Göcek Bay
16	I-127	675923	4066051	Inlice	**96**	F-4	688268	4057693	Fethiye-Göcek Bay
17	I-135	675938	4066008	Inlice	**97**	F-3	688386	4056817	Fethiye-Göcek Bay
18	I-110	675968	4066030	Inlice	**98**	F-2	688363	4056177	Fethiye-Göcek Bay
19	I-105	675952	4065951	Inlice	**99**	F-1	687939	4055601	Fethiye-Göcek Bay

1.1. Evaluation of the Data

The Itrax Core scanner combines X-ray reflectance (XRF), radiographic x-ray imaging, and optical imaging, and is applicable to split sediment cores, rock cores and other samples (Croudace et al., 2006). It gives information about the semi-quantities count of the 25 elements (e.g. Rodriguez-Germade et al., 2013). The results of units as count per second (cps). The radiographic imaging analysis, shows from light to dark images base on density of the material measured. The Mo tube is suitable for both transition and heavy elements while the Cr tube is appropriate for lighter elements, i.e., Al, Si, P, S, K and Ca. XRF is not a suitable method for all elements and which elements are acquired during an analysis depends on the actual concentration of that element in the sample and how long each step is analysed for (e.g. Rodriguez-Germade et al., 2013). The ITRAX micro- XRF elemental analysis was performed in every 2 mm for Köyceğiz samples and in every 1 mm for Fethiye-Göcek samples (artificial cores) with 12 seconds of time increments.

ITRAX principle is excitation of electrons by x-radiation. The electron which is in the inner atomic shells was removed from the vacancies by the radiation (Figure 2.6.). This is filled by electrons falling from outer shells and high amount of energy emitted bythe secondary X-radiation (Weltje et al., 2008).

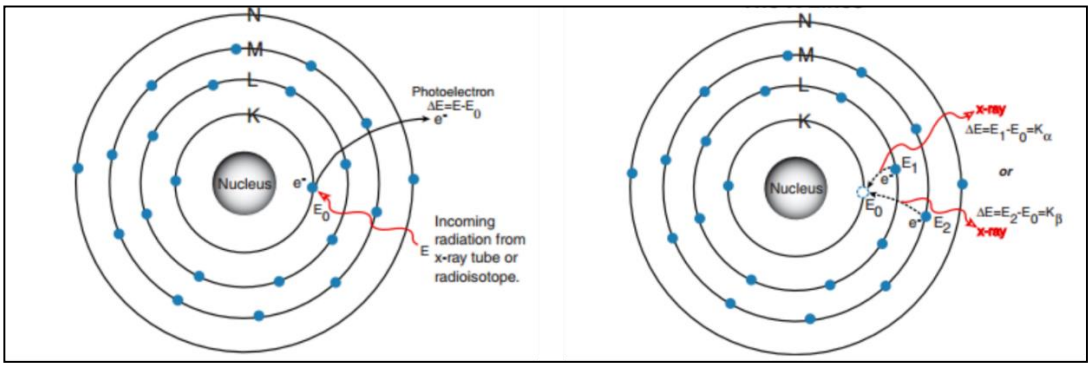

Figure 2.6. Principle of ITRAX micro-XRF (http://www.amptek.com)

ITRAX scanner has a Mo-anode X-Ray tube in different voltages and current. it shows that medium-heavy elements to lighter elements (Fig. 2.7).

ITRAX gives semi quantitative elements results some elements from periodic table which are Si, Al, S, Cl, K, Ca, Ti, Fe, As, Pb, Zn, Br, Rb, Sr, Zr, Ba (Croudace et al., 2006).

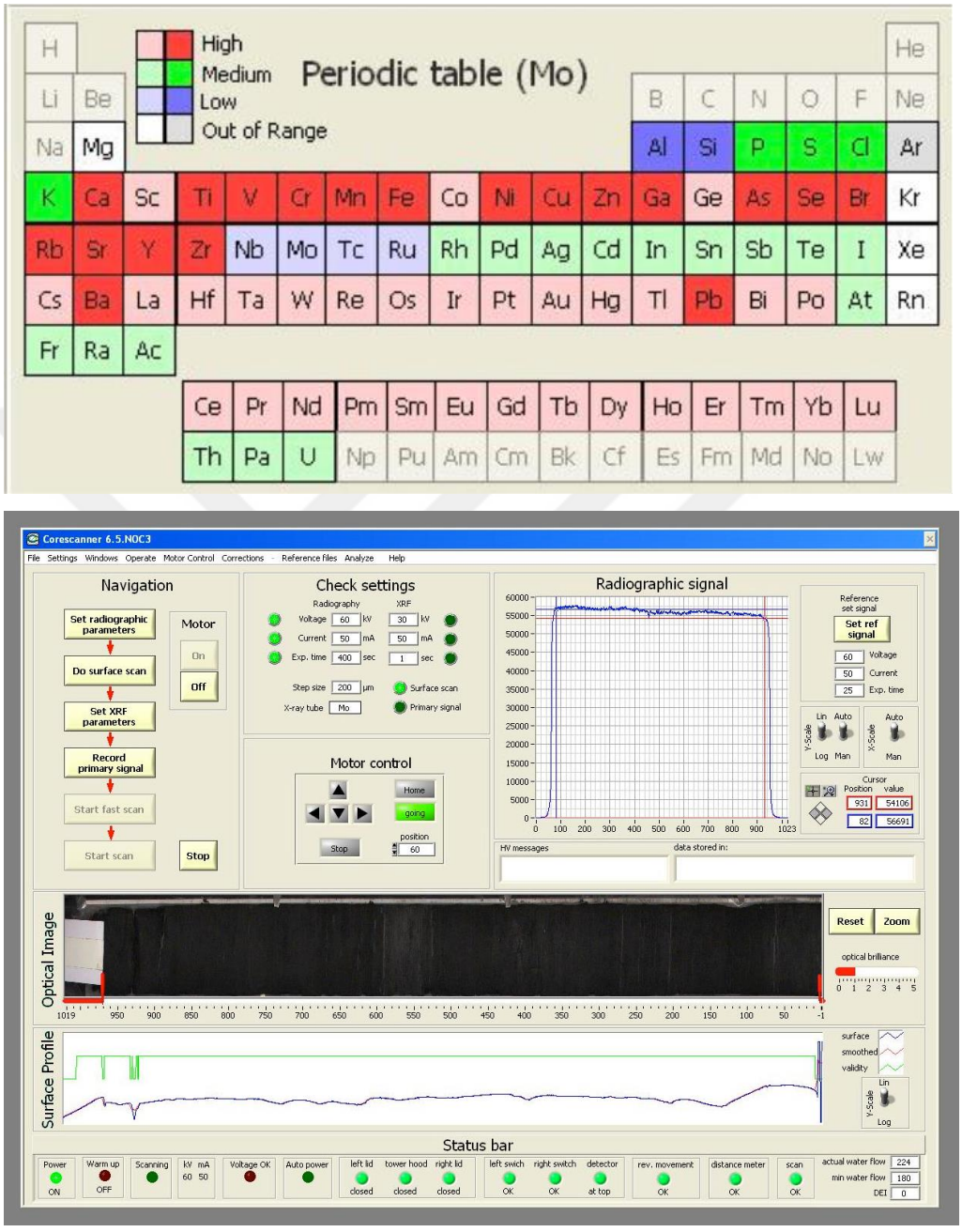

Figure 2.7. Detection of Elements in ITRAX micro-XRF scanner (British Ocean Sediment Core Research Facility, 2012).

After receiving the ITRAX results, raw data is edited according to previously recorded core lengths. Optical and radiographic images were also used. This data separation process was very important process for observing the spatial distribution of elements.

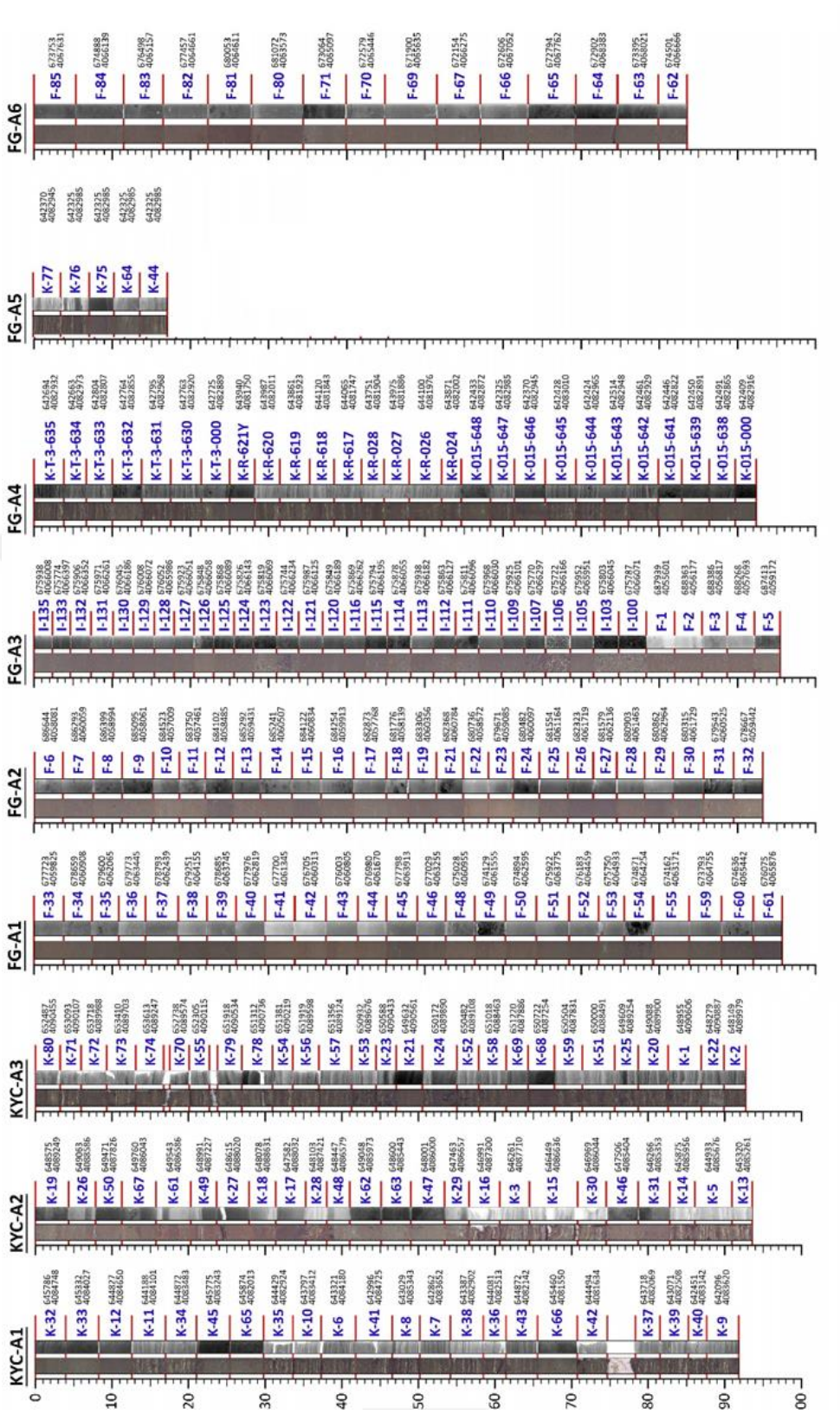

Figure 2.8. Optical, radiographically images of the artificial cores that were formed from gravity cores. The coordinates of the core locations are also presented next to the core (modified from Avşar et al., 2015)

3. RESULTS AND DISCUSSIONS

1.2. Results of Geochemical Analysis

This part includes the results of geochemical data results. In laboratory studies, when the artificial cores were prepared, cores lengths were recorded. After these artificial cores were scanned, the results of raw data are separated according to core length and RGB photos (Figure 3.1.a.b.). They were scanned by ITRAX micro-XRF scanner. The Köyceğiz Lake samples were measured in 2 mm increments while Fethiye - Göcek Bay samples were scanned in 1 mm increments in every 12 seconds. These results are in count per second and these are semi-quantitative results. For example, K-32 core, which was gathered from Köyceğiz Lake, has 19 elements results. Since, there is one measurement in every 1 mm there is 12 measurements for19 elements. (Figure 3.1c). For simplification, average of all measurements for one element was taken and this mean value was used in the spatial distribution maps for that point /core. Every elements result are averaged for a simple using (Figure 3.1. c. d.).

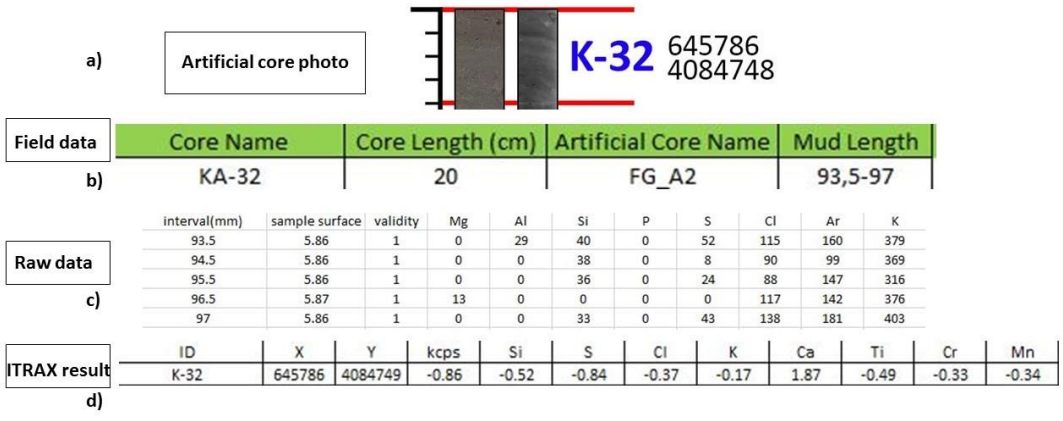

Figure 3.1. Separation the ITRAX results.

Data evaluation is such an important process. The data should be normalized or standardized to bring all of the variables into proportion with one another (Etzkorn B.,

2012). Summary of the standardize, traditionally this means to fit the data within unity. Generally using this process which is shown below:

$$X_{i,\,0\text{ to }1} = \frac{X_i - X_{Min}}{X_{Max} - X_{Min}}$$

X_i = Each data point i

X_{Min} = the minima among all the data points

X_{Max} = the maxima among all the data points

$X_{i,\,0\text{ to }1}$ = the data point i normalized between 0 and 1

When the data is normalized like that this equation, z-score is found which is the number of standard deviations from the mean of data point (Etzkorn B., 2012).

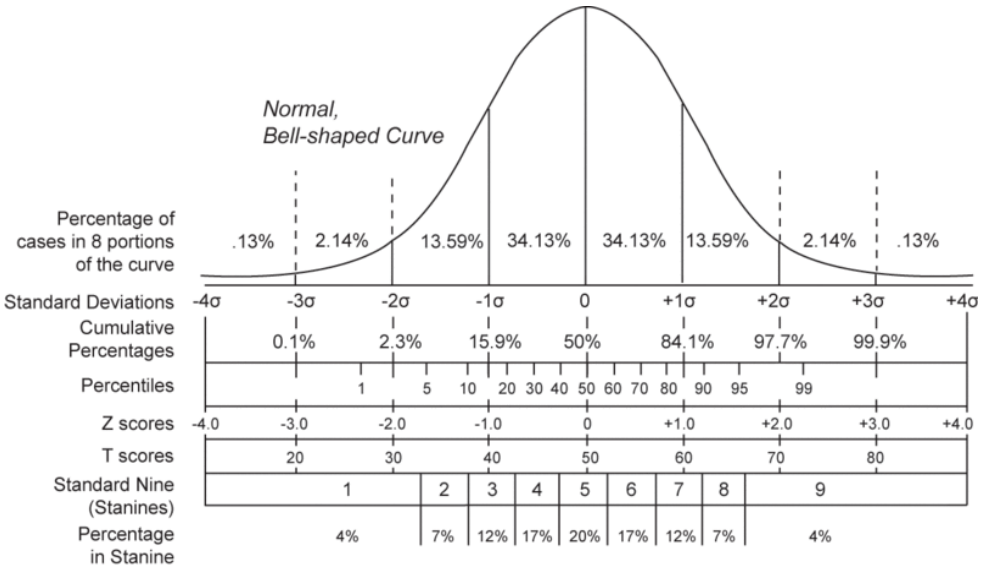

Figure 3.2. Data normalize equation graphic

To determine the Z-Score of each data point, the following equation should be used:

$$X_{i,\,1\sigma} = \frac{X_i - \bar{X}_S}{\sigma_{X,\,S}}$$

Where:

X_i = Each data point i

$_S$ = the average of all the sample data points

$_{X, S}$ = the sample standard deviation of all sample data points

$X_{i, 1\sigma}$ = the data point i standardized to 1σ, also known as Z-Score

The conclusion from this experiment is that data should be normalized or standardized to remove their scale from maps but both techniques includes same results. Generally, standardizing is the preferred method because it produces meaningful information about each data point (Etzkorn B., 2012).

ITRAX results are standardized using these equations. When the standardized data and the raw data is compared the difference is not too much. After this process, our data is usable for spatial distribution maps.

1.3. Spatial Distribution of the Elements

This part includes spatial distribution maps of Köyceğiz Lake and Fethiye-Göcek Bay for the measured elements. The standardized average data was used for spatial distribution map of the elements. Kriging Method was used for the preparation of the interpolation maps, with the help of ArcGIS computer program. Interpolation is the process of obtaining a value for a variable of interest at a location where data has not been observed, using data from locations where data has been collected (Krivoruchko, 2011). This method based on estimation of a variable at unmeasured location from observed values at surrounding locations (Bohling, 2005). A mathematical model may be fitted to the experimental variogram and the coefficients of this model can be used for spatial prediction using kriging or for conditional simulation (Lloyd, 2010). There are four components of kriging method. These are sill, nugget, range and lag. The nugget effect, c0 represents unresolved variation (a mixture of spatial variation at a

finer scale than the sample spacing and measurement error). The structured component, c, represents the spatially correlated variation. The sill (or sill variance), c0+c, is the a priori variance. The range, *a*, represents the scale (or frequency) of spatial variation.

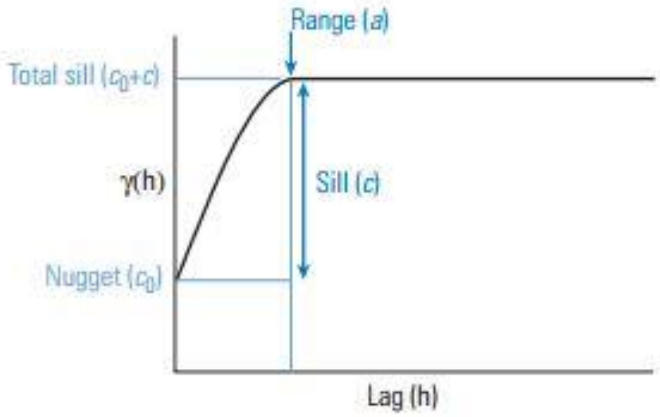

Figure 3.3. Bounded variogram model.

Other important points are the mean and standard deviation. These parameters are defined before application of this method. Standardized ITRAX data is normally distributed. If data is log-normal distribution and skewness is smaller than 1, this is right way for spatial distribution analyses (Lloyd, 2010).

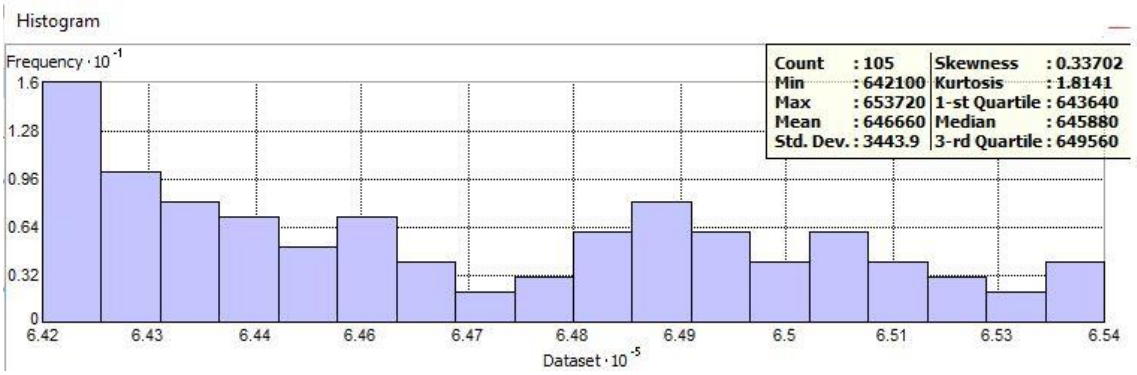

Figure 3.4. Histogram and skewness value of ITRAX results.

After standardizing process, spatial distribution maps were drawn using by ArcGIS, with Empirical Bayesian Method. This method is chosen because, it has satisfactory estimation of variable at an unmeasured location from observed values at surrounding

locations. All interpolation maps estimate the value at a given location as a weighted sum of data values at surrounding locations. In addition to these advantages, there is an estimation error along with the estimate of variable, according to Z value (Bohling, 2005). Spatial distribution maps of 19 elements were prepared for Köyceğiz Lake and Fethiye- Göcek Bay. Four elements (Cl, Br, Mn, S) show an anomaly around the hot and cold springs in Köyceğiz Lake and four elements (Cl, S, Ca, Sr), show an anomaly around the subaqueous hot springs in Fethiye-Göcek Bay. Spatial distribution maps of the elements that do not show an anomaly, are given in Appendix 1. In addition, semi quantitative ITRAX-XRF data which were standardized are presented in Appendix 2. In addition to this, anomalous map are drawn and their error maps are drawn in ArcGIS programme.

It should be noted that, the sediments around the Köyceğiz subaqueous hot springs, there is a positive anomaly in elements S, Cl, and Br, (Fig. 3.5, 3.6, 3.7) while there is a negative anomaly in Mn (Fig. 3.8). Similarly, in the Fethiye - Göcek Bay, the sediments around the subaqueous hot spring there is a positive anomaly in S, Cl, Ca, and Sr (Fig. 3.9, 3.10, 3.11, 3.12). Similar anomalies exist in the south of Göcek Island but no detailed water temperature measurement conducted at that point for catching subaqueous hot spring. In previous studies in Köyceğiz Lake and Fethiye-Göcek Bay which is supervisor of Özgür Avşar is found the hot spring and this is said that previous chapter in this thesis. Saturated index is measured in this hot springs. When observing the saturated index results. Ca element is high saturated aragonite, calcite, dolomite, and fluorite. Ca element is positive anomaly in Fethiye-Göcek Bay. It is possible that, the reason for the Ca element is high anomaly in the sediments as a result of the ITRAX analysis is that the minerals listed above probably precipitate from the hot springs (Avşar, 2015). Sr element has similar chemical properties Ca. S is high anomaly in Fethiye-Göcek and Köyceğiz Lake sediments around the hot springs.

In addition, the Selestite mineral, which occur high anomaly both the S and Sr elements in ITRAX measurements, they provides negative saturation index values at all temperatures Therefore, it is unthinkable that the Selestite mineral was deposited around the hot springs. However, the Selestite minerals do not offer values far from zero when the saturation index values are examined. The results from the ITRAX analysis are the average results of the sediments at 5-6 cm depth from the surface while

the water chemistry data gives the current state of the present day, and the average of precipitated minerals in the past. Although today's water chemistry does not allow these minerals to precipitate, small changes in the water chemistry results of the past may have caused the Selestite and Anhydrite minerals from the hot springs and also give an anomaly around it.

It is generally known that, when Cl element is separated from its mineral bonds once and passes through the water as an ion, it is almost impossible to bond with another element and pass it to the mineral form. So that, saturation index values of Halite and Silvite minerals of hot springs are very negative. The anomaly of Cl element in ITRAX results in the mineral state is not explained by the classical geochemical model and it is outside the scope of this study. Cl and Br is similar chemical properties, so Br element is not explain by the classical geochemical model (Avşar, 2015). However, in the future this location should be studied in detail, to solve this problems.

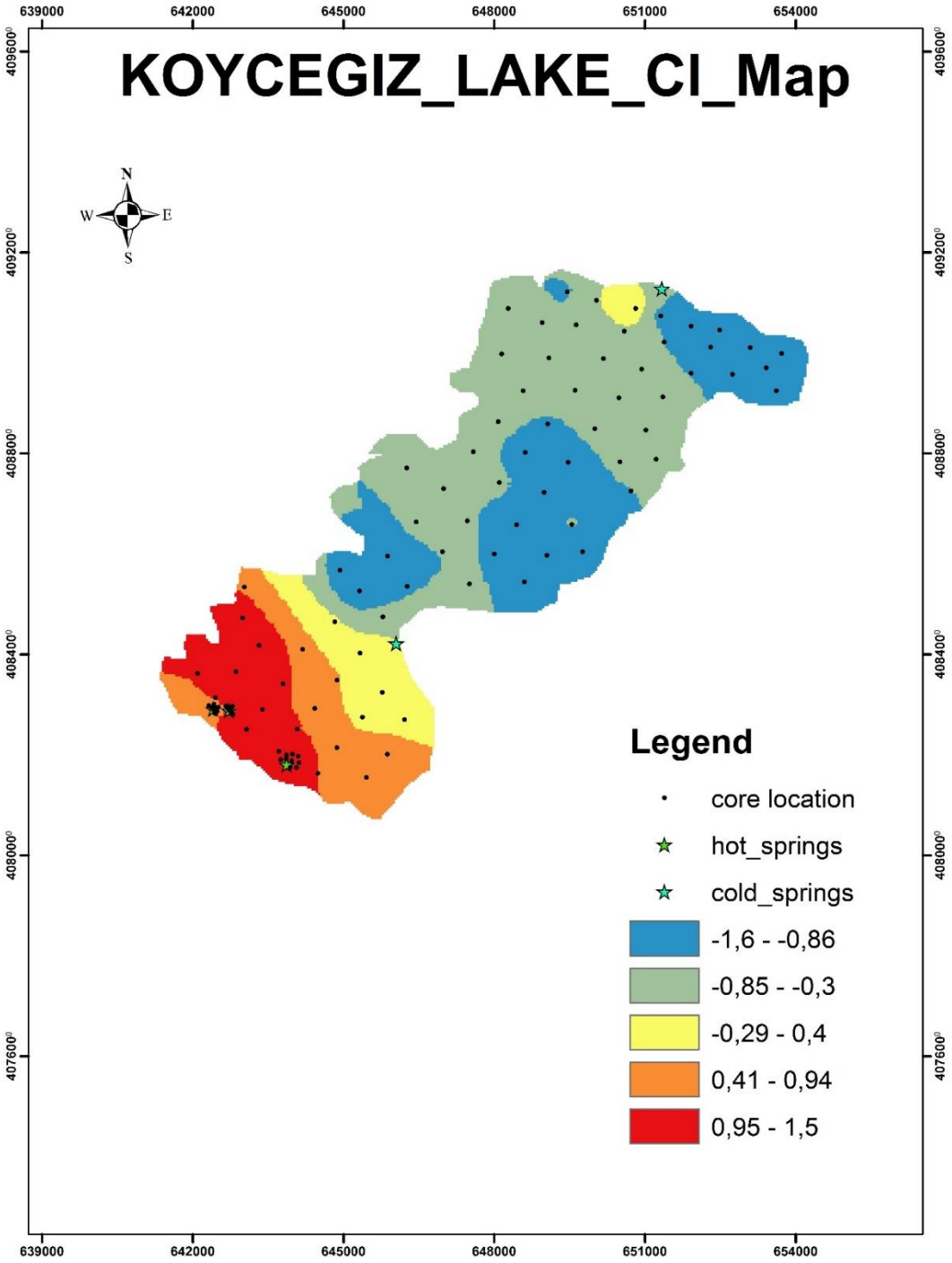

Figure 3.5. Spatial distribution maps of Cl in Köyceğiz Lake.

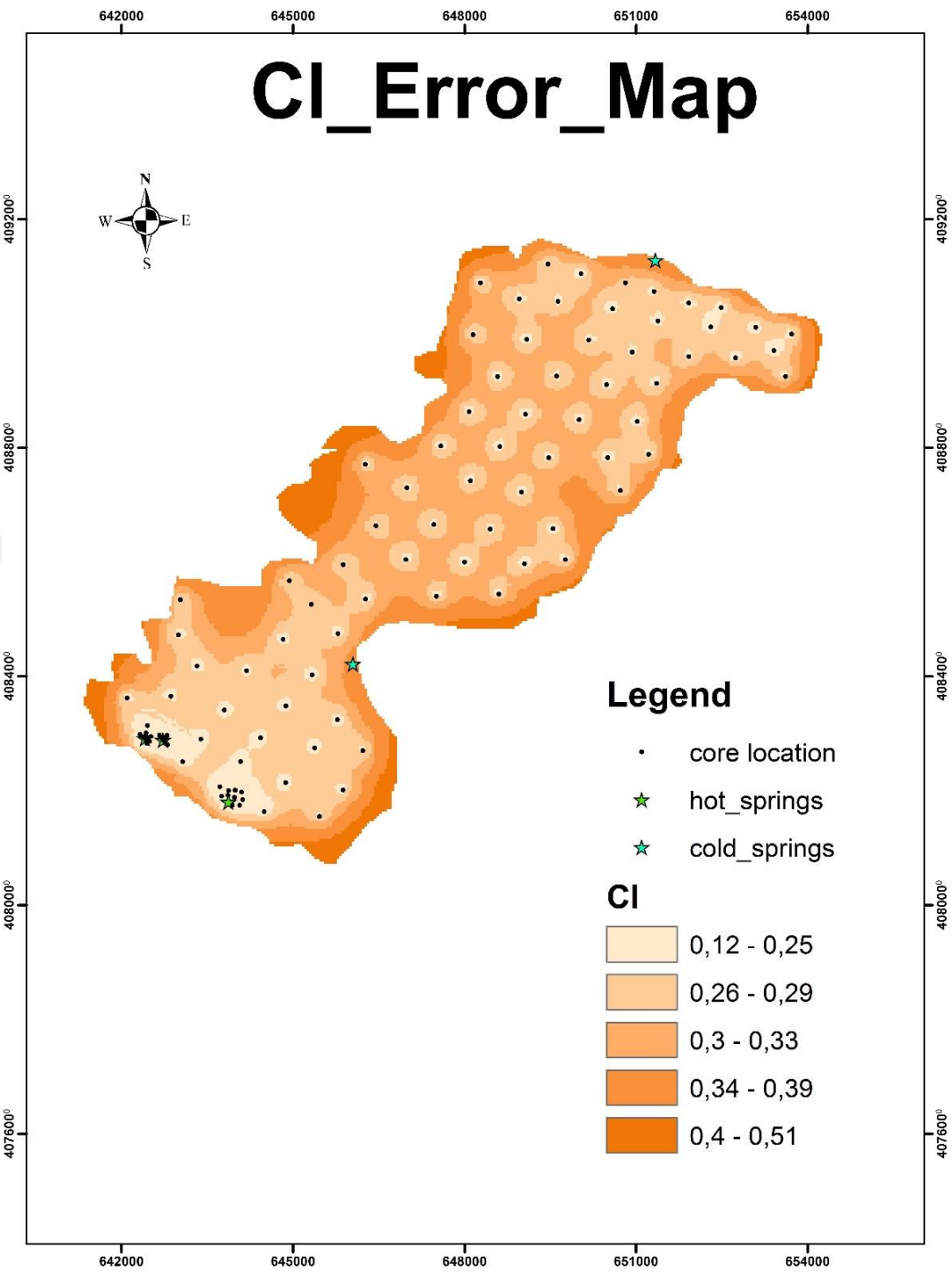

Figure 3.6. Error maps of Cl in Köyceğiz Lake.

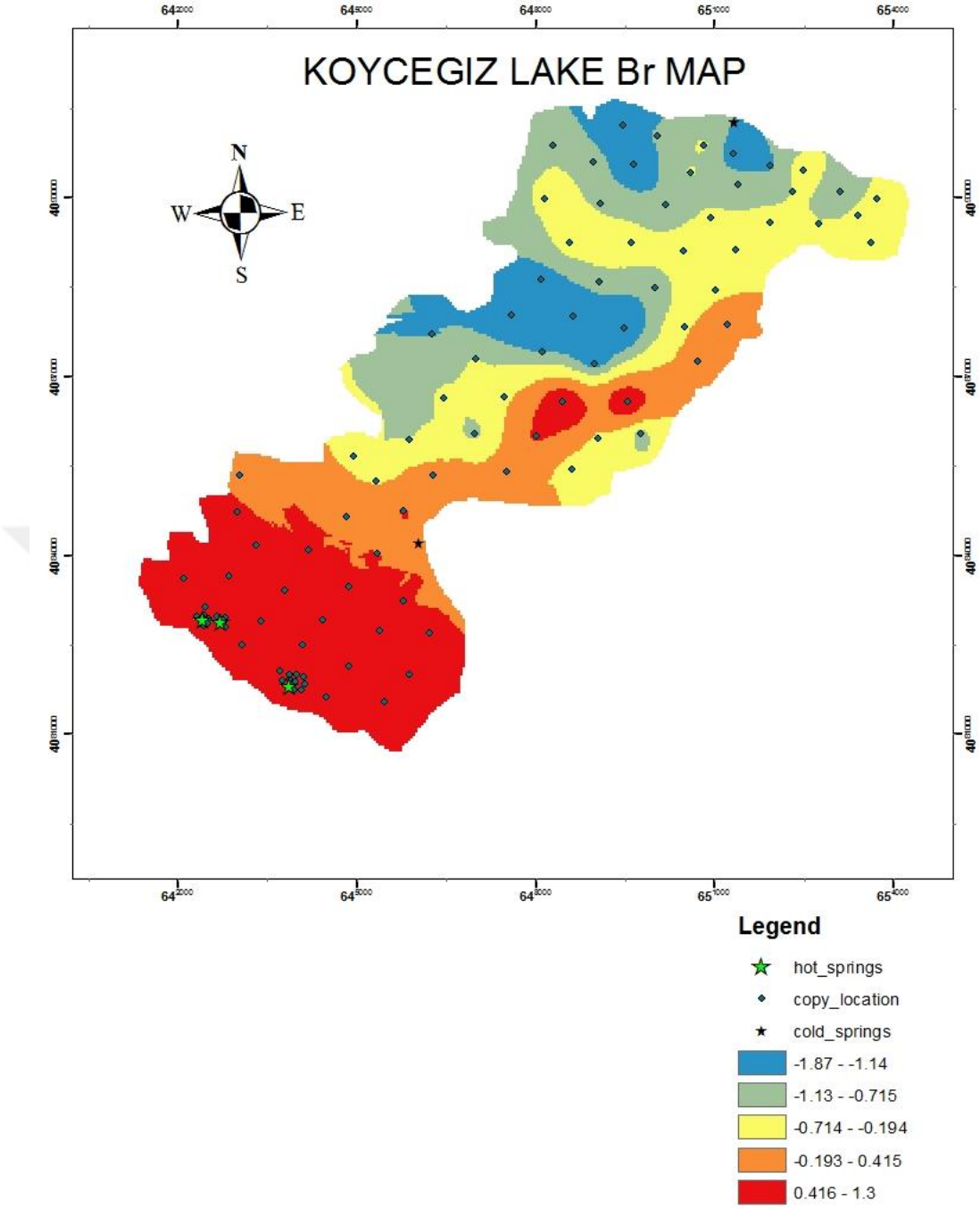

Figure 3.7. Spatial distribution maps of Br in Köyceğiz Lake.

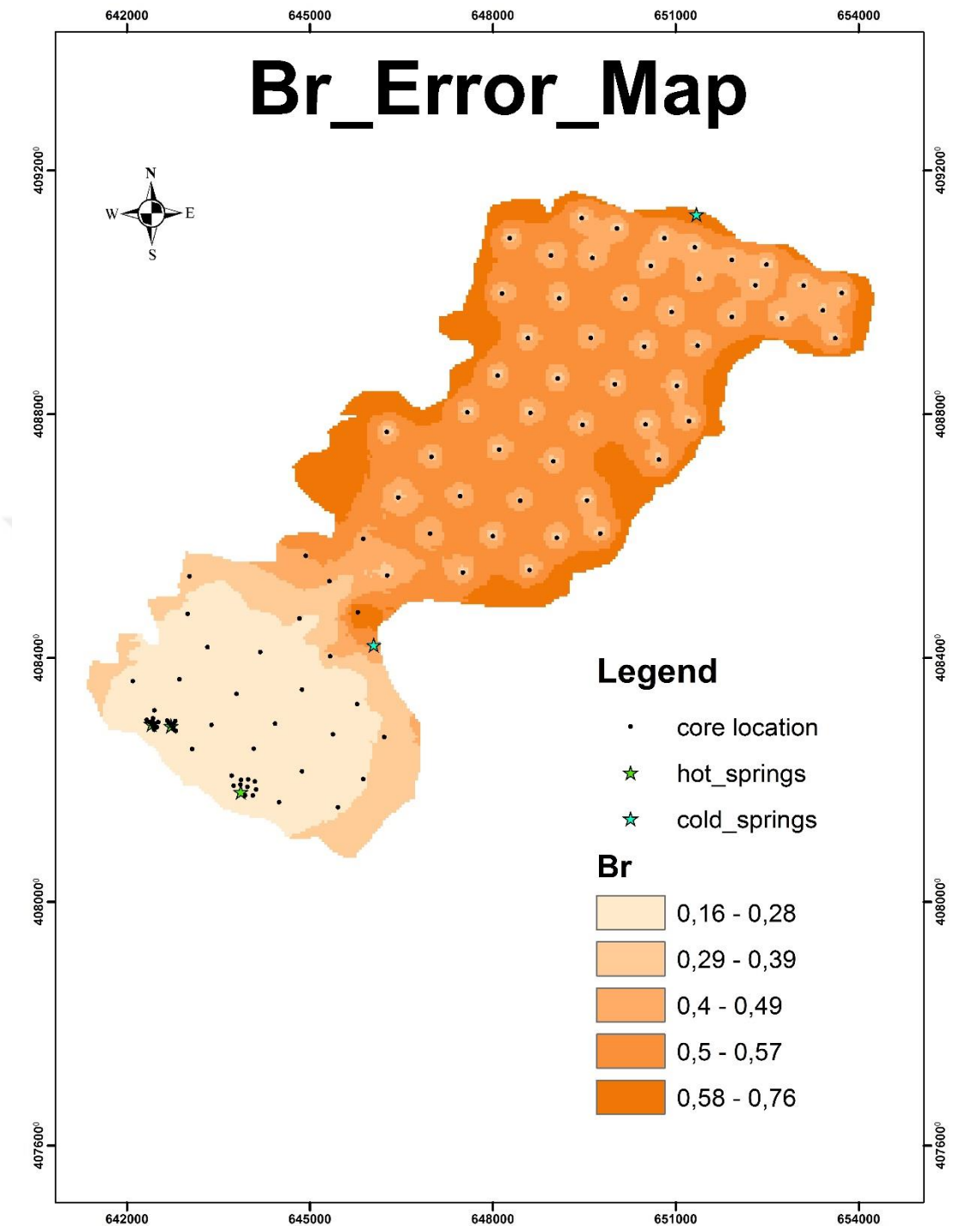

Figure 3.8. Error maps of Br in Köyceğiz Lake.

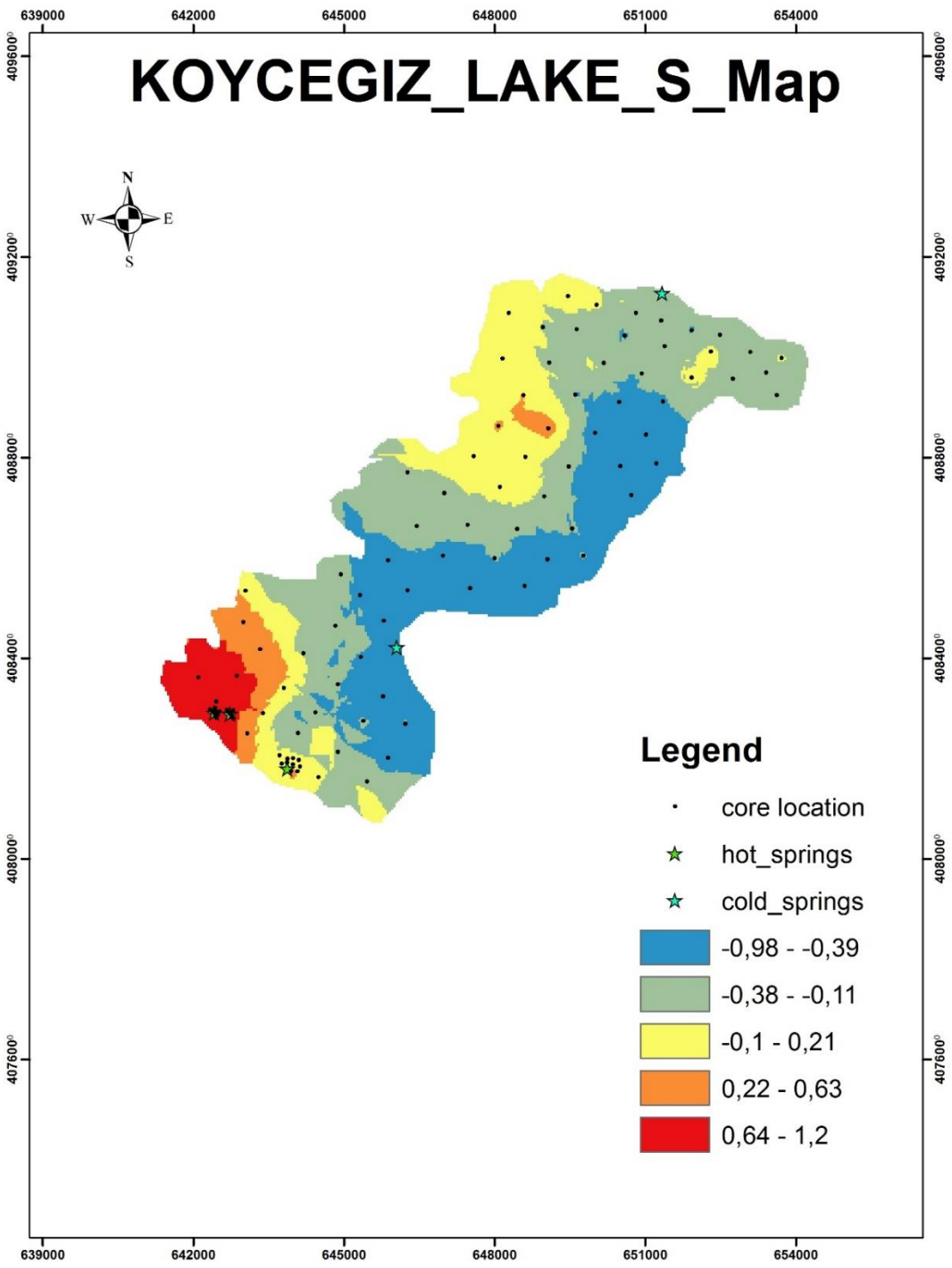

Figure 3.9. Spatial distribution maps of S in Köyceğiz Lake.

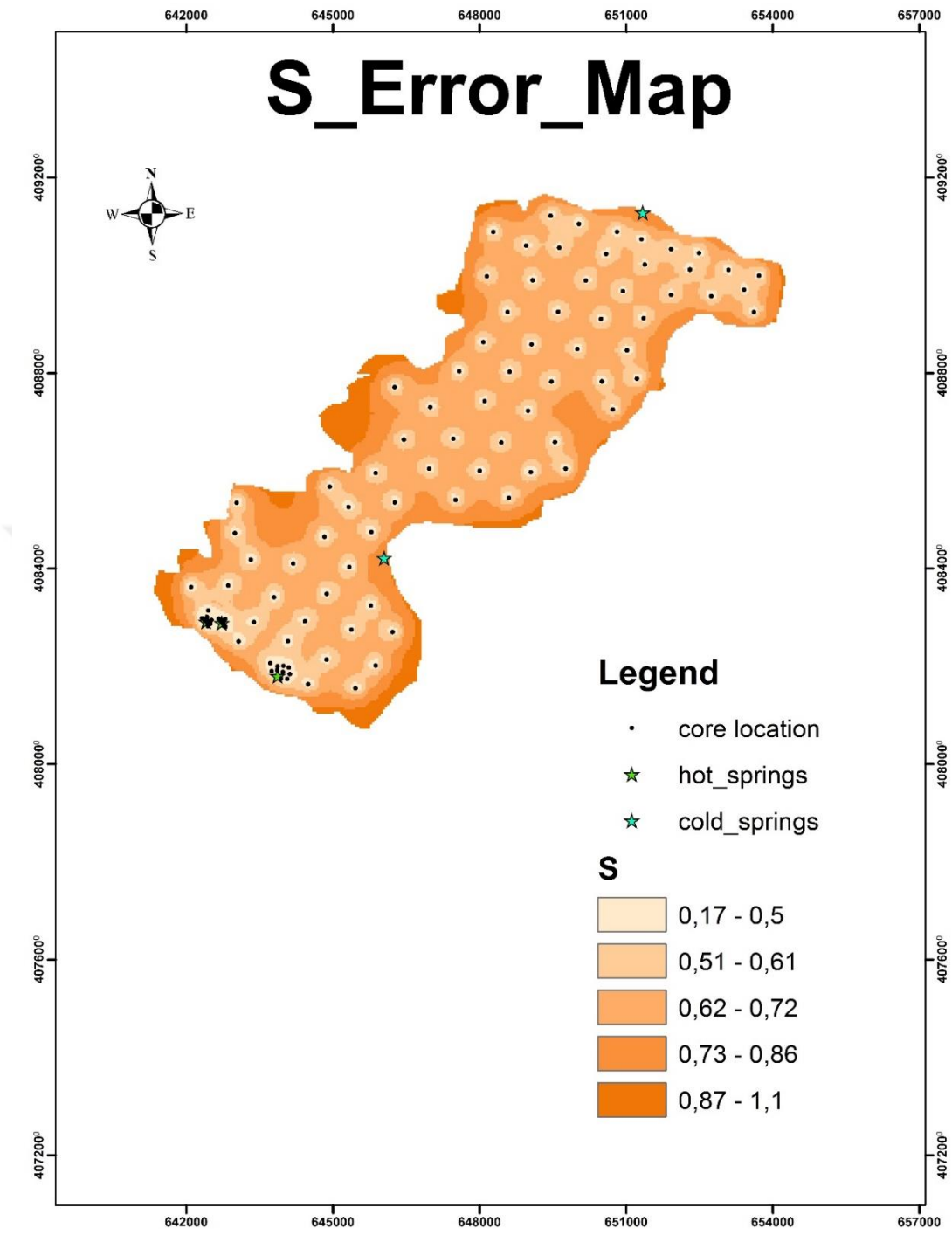

Figure 3.10. Error maps of S in Köyceğiz Lake.

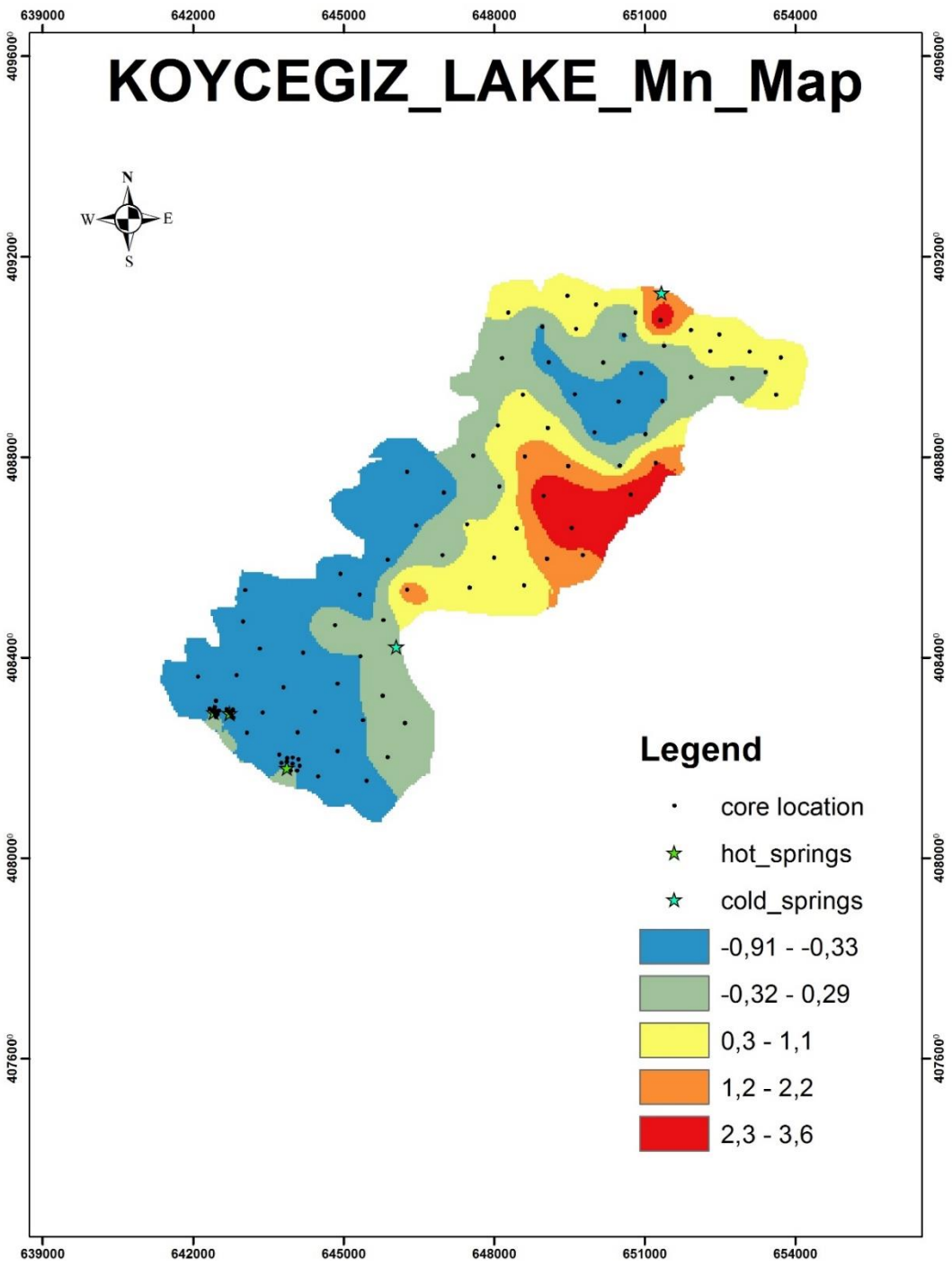

Figure 3.11. Spatial distribution maps of Mn in Köyceğiz Lake.

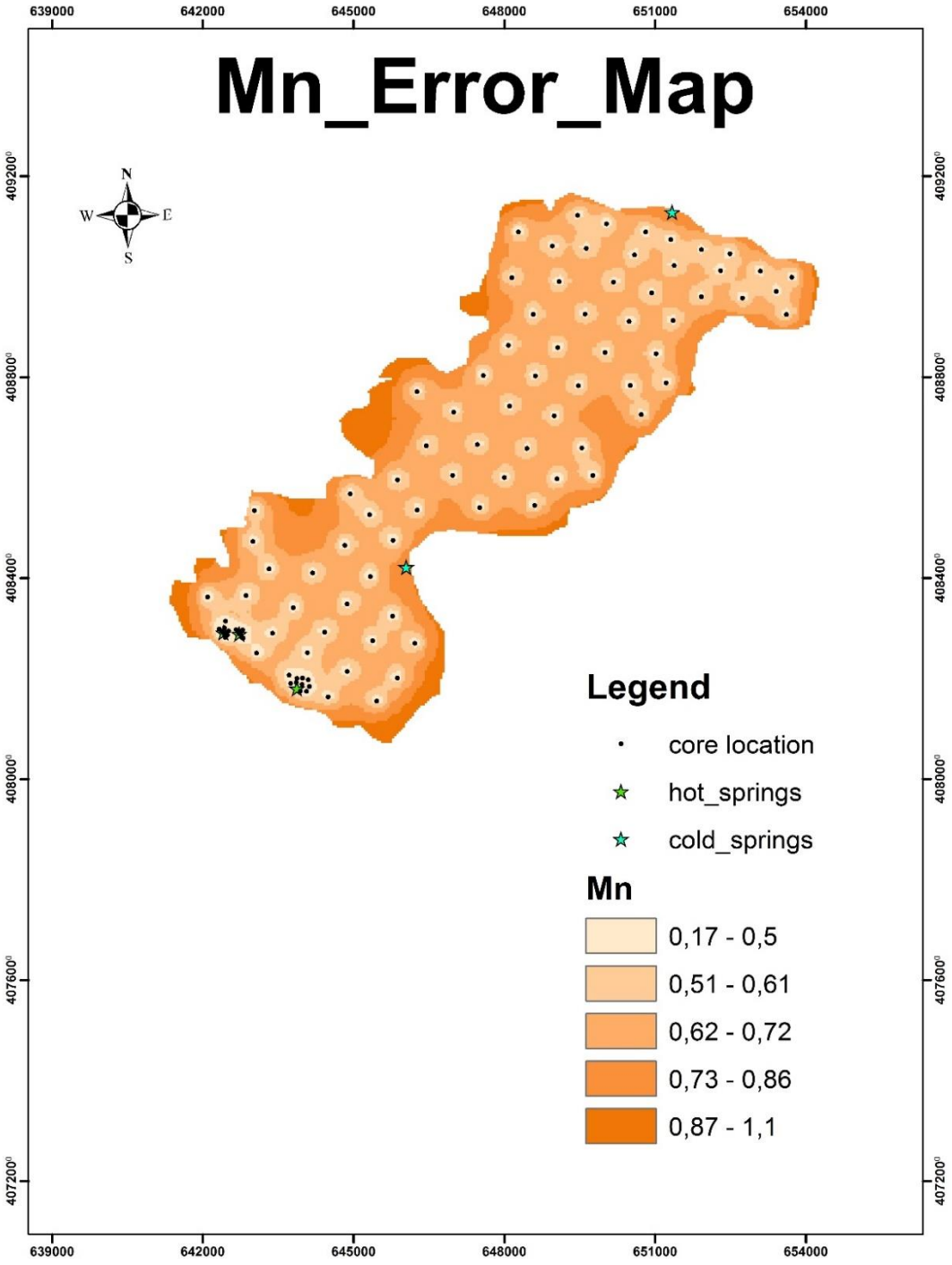

Figure 3.12. Error maps of Mn in Köyceğiz Lake.

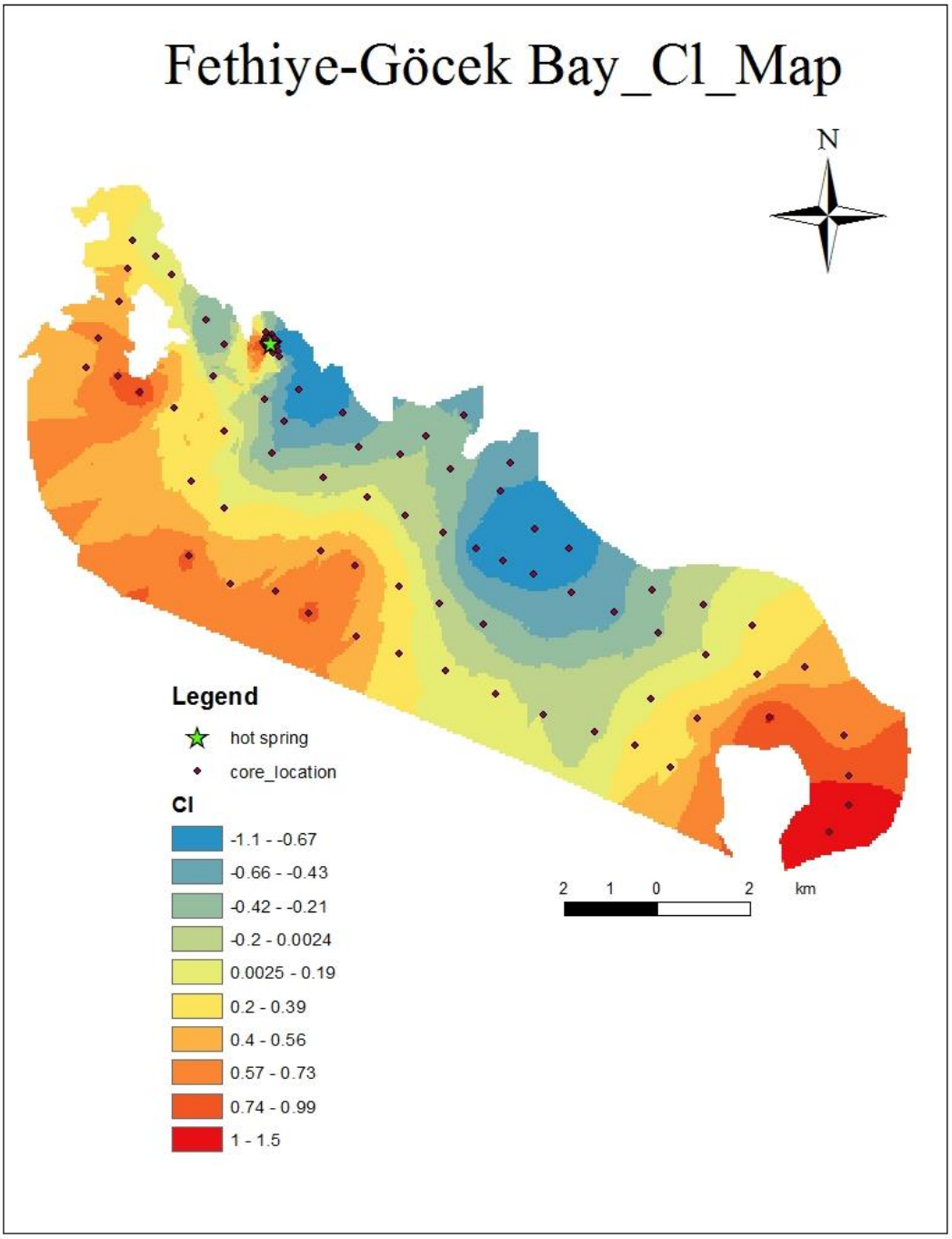

Figure 3.13. Spatial distribution maps of Cl in Fethiye-Göcek Bay.

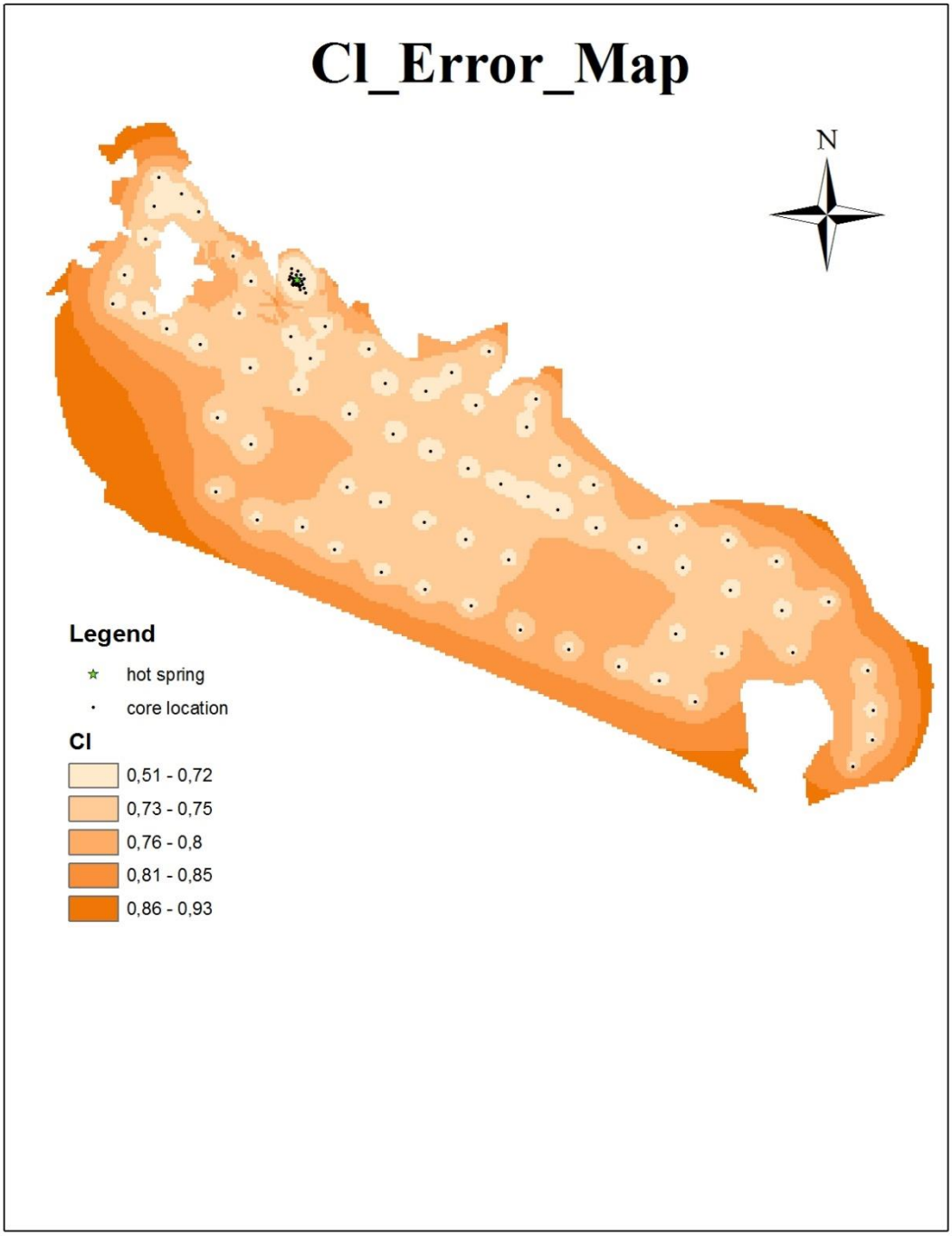

Figure 3.14. Error maps of Cl in Köyceğiz Lake.

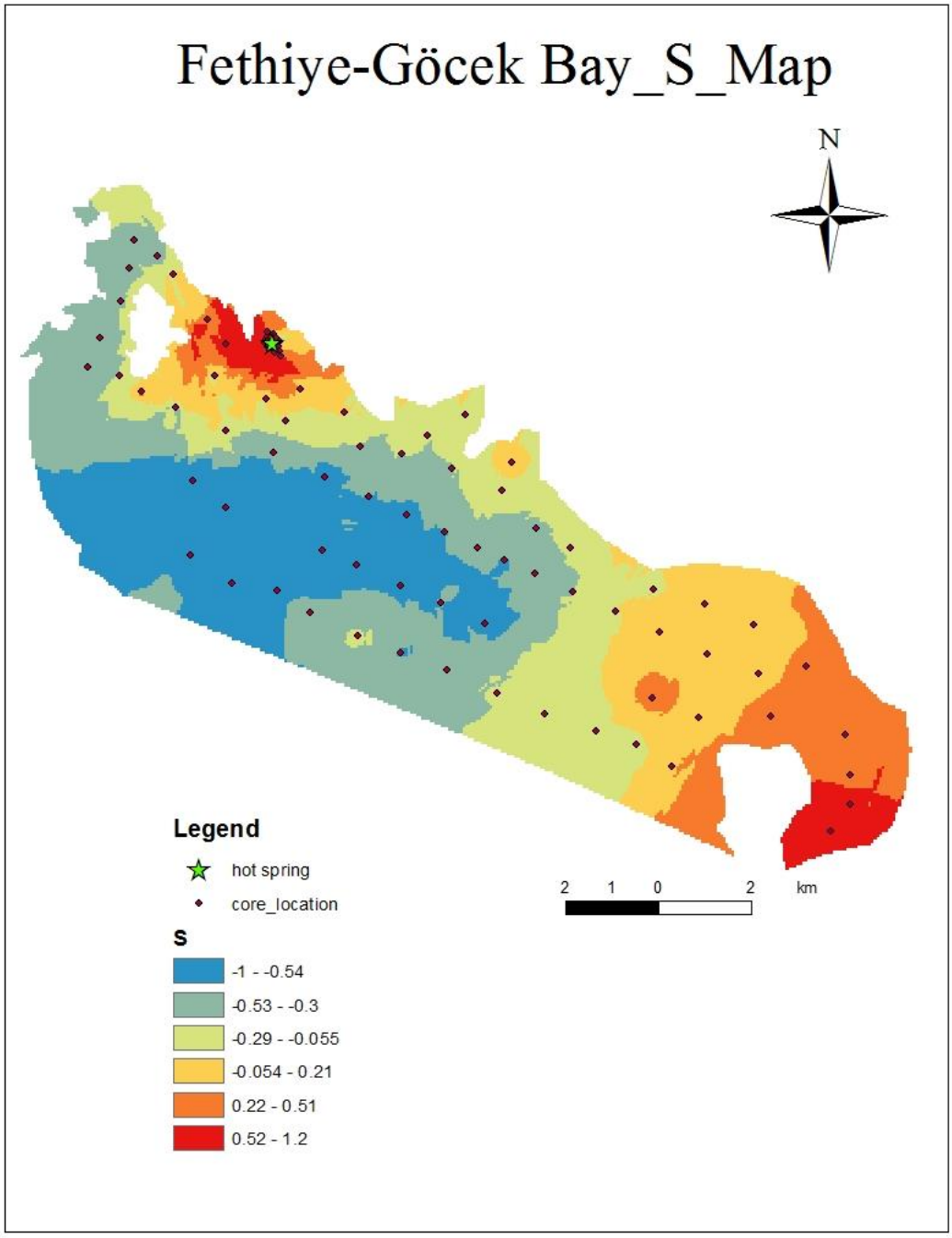

Figure 3.15. Spatial distribution maps of S in Fethiye-Göcek Bay.

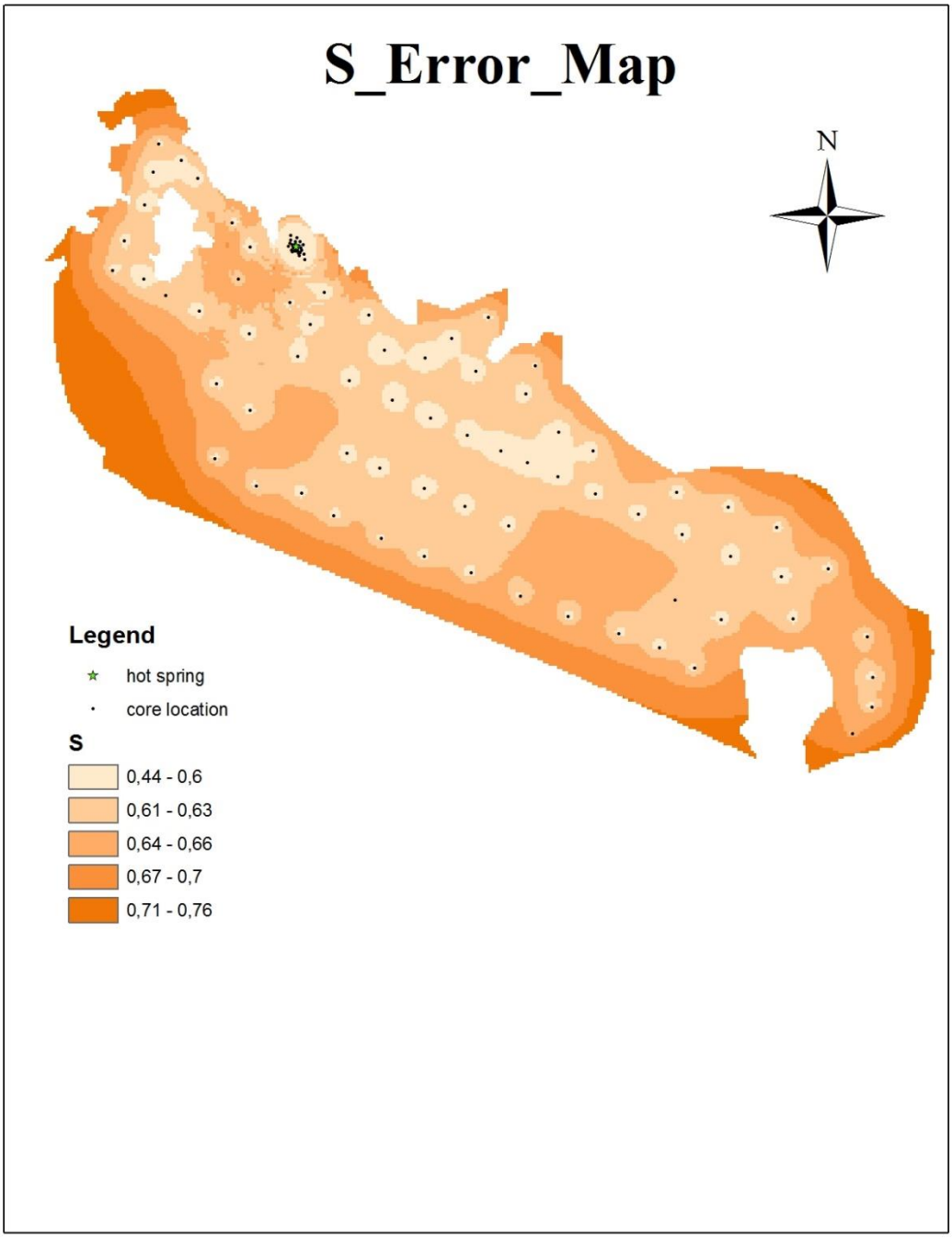

Figure 3.16. Error maps of S in Fethiye-Göcek Bay

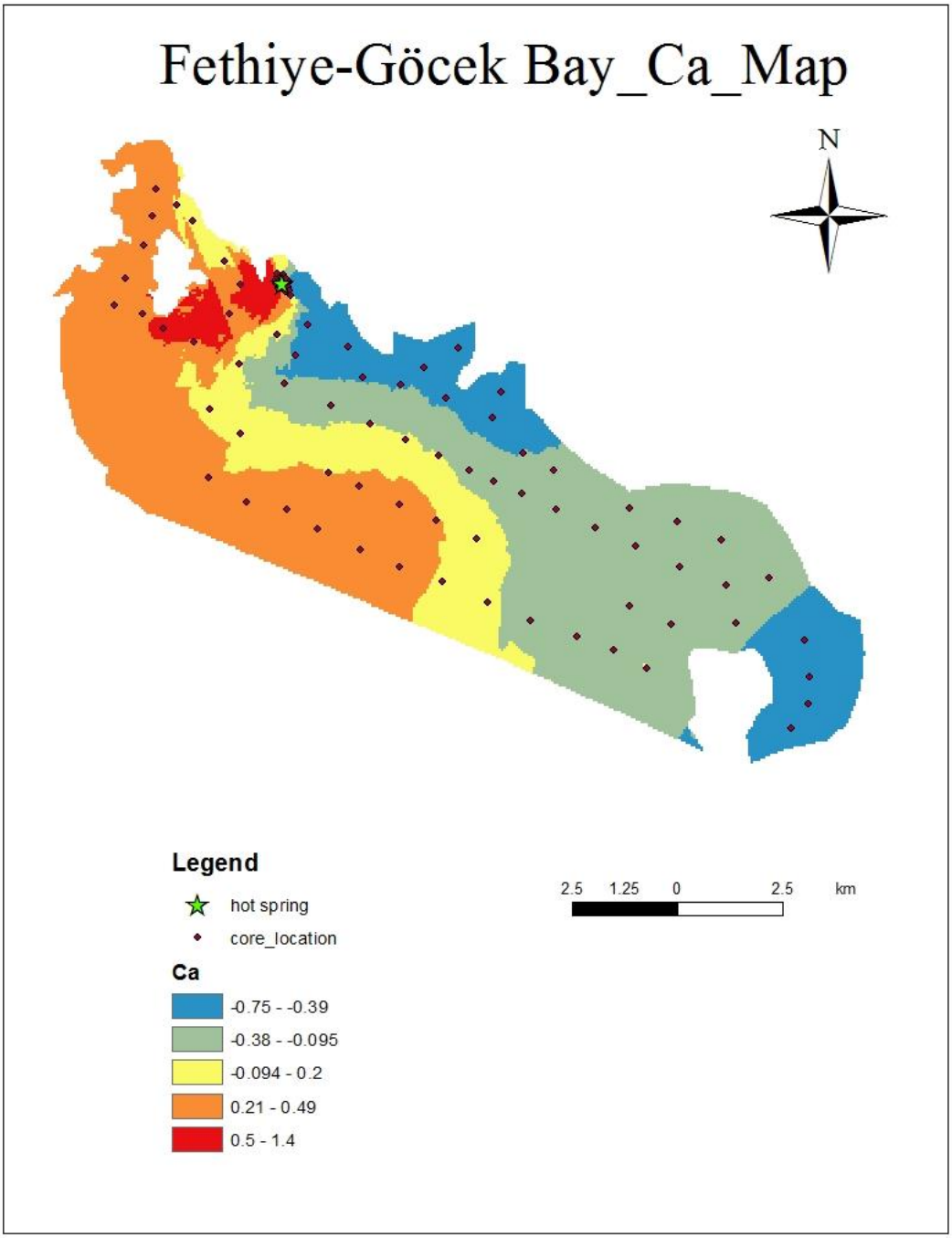

Figure 3.17. Spatial distribution maps of Ca in Fethiye-Göcek Bay.

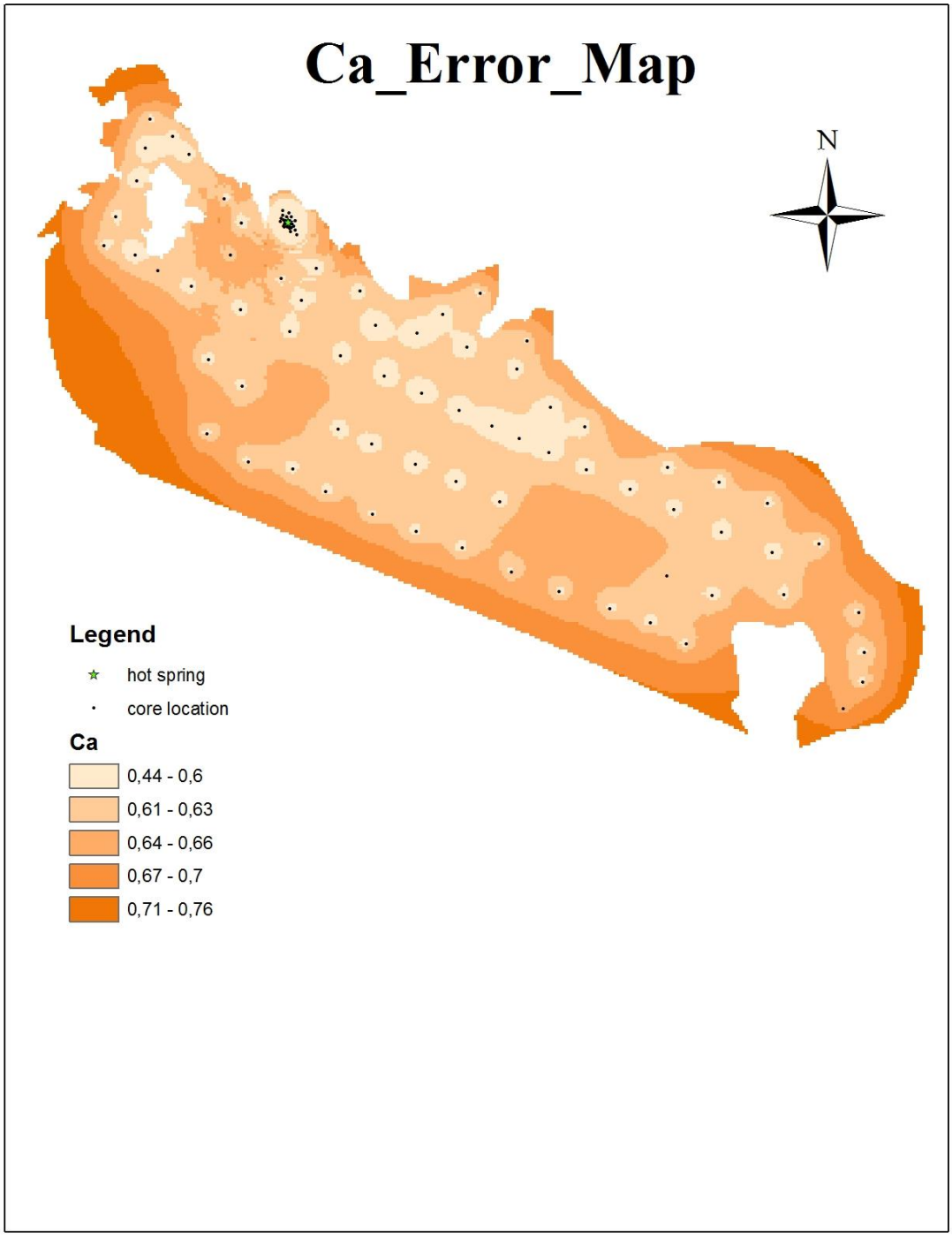

Figure 3.18. Error maps of Ca in Fethiye-Göcek Bay

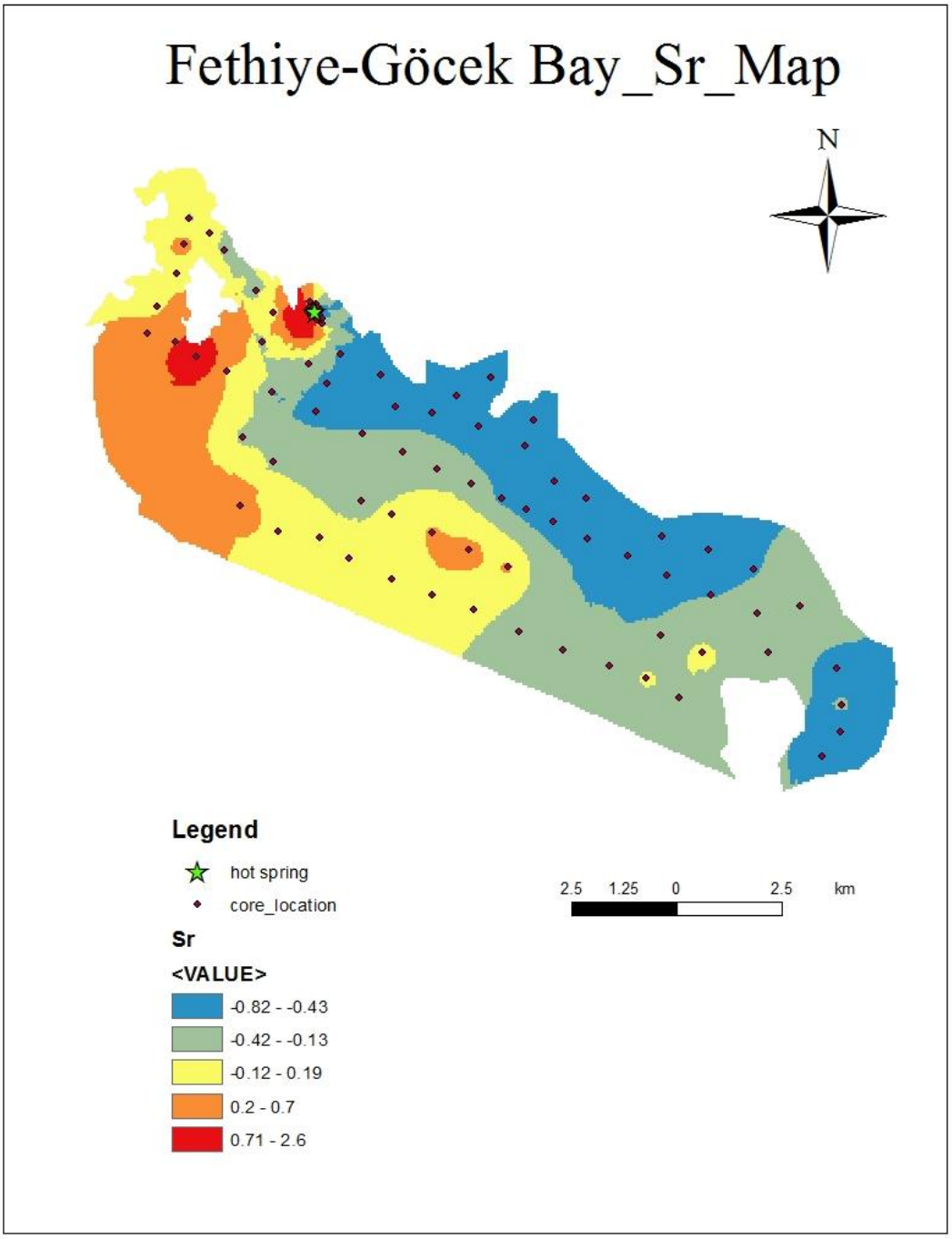

Figure 3.19. Spatial distribution maps of Sr in Fethiye-Göcek Bay.

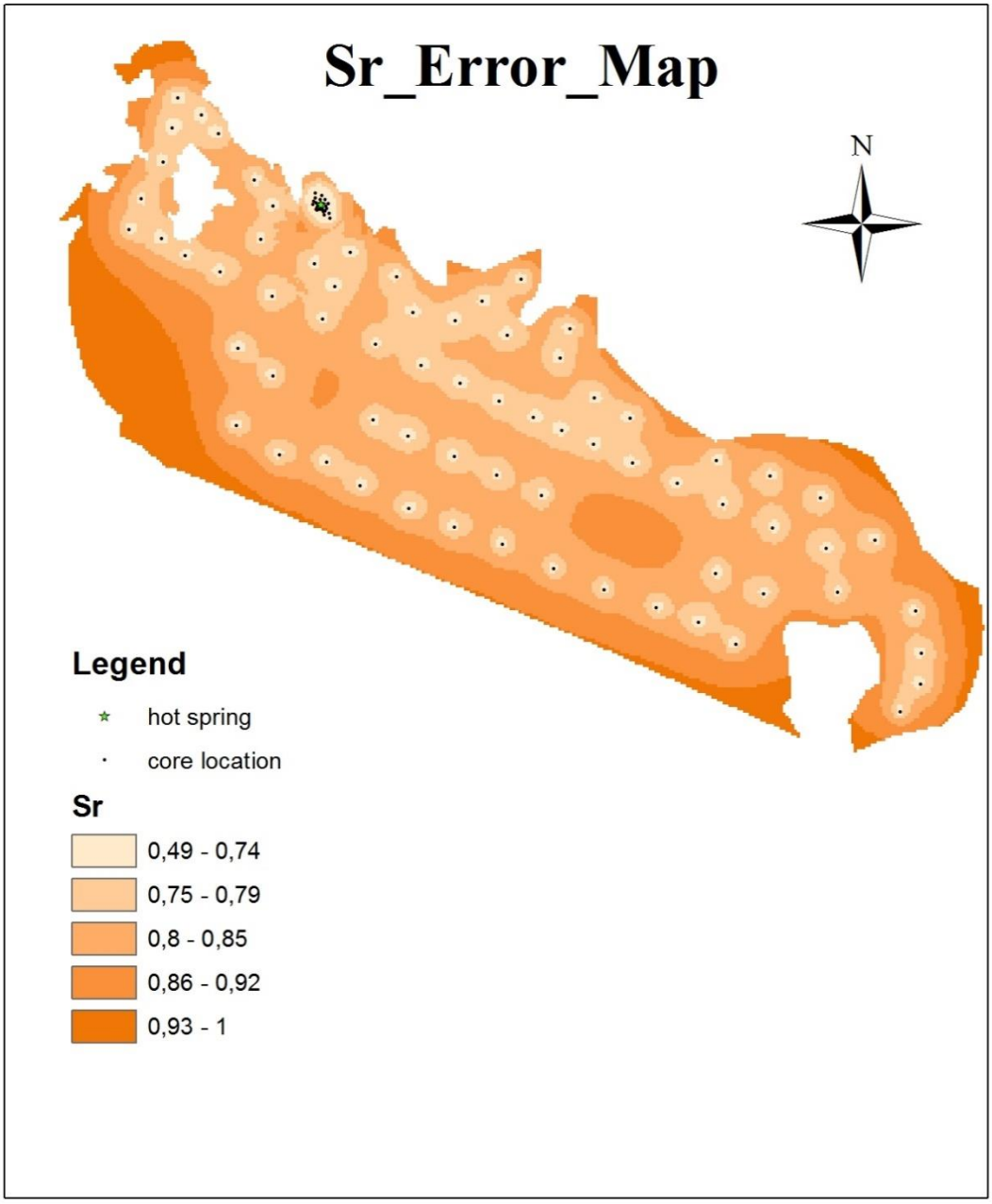

Figure 3.20. Error maps of Sr in Fethiye-Göcek Bay

CONCLUSIONS

From this study, the following conclusions were drawn:

1. Spatial distributions of Cl, Br, and S elements are displaying a positive anomaly around subaqueous hot springs in Köyceğiz Lake.
2. Spatial distributions of Mn element has a negative anomaly around subaqueous hot springs in Köyceğiz Lake.
3. In Fethiye - Göcek Bay, spatial distributions of Cl, S, Ca and Sr elements have positive anomaly around the subaqueous hot spring.
4. In Fethiye-Göcek Bay and Köyceğiz Lake sediments are affected by the subaqueous thermal hot springs and this may be used in prospecting subaqueous hydrothermal resources. The sediments are not affected by the subaqueous cold springs.

REFERENCES

Ankut, Z., Avşar Ö., Avşar U., Arslan Ş., Kurtuluş B., Güleç N. 2015. Köyceğiz Gölü Tabanındaki Çökellerin Jeokimyasal Özelliklerinin Alansal Dağılımının İncelenmesi ve SuaItı Jeotermal Kaynakların Bu Özelliklere Etkisi.68. Türkiye Jeoloji Kurultayı, 6-10 Nisan 2015, Ankara, Türkiye.

Avşar, Ö., Avşar U., Arslan Ş., Kurtuluş B., Güleç N. 2015. Fethiye-Göcek Körfezi ile Köyceğiz, Alagöl, Sülüngür ve Kocagöl Göllerinin Tabanındaki Termal Kaynakların Alansal Dağılımının ve Hidrokimyasal Özelliklerinin Belirlenmesi Nisan 2015, Tubitak 1001 Projesi (#112Y137) Final Raporu.

Bayarı, C.S., Kazancı, N., Koyuncu, H., Çağlar, S.S; and Gökçe, D., 1995. Determination Of The Origin Of The Waters Of Köyceğiz Lake, Turkey; Journal Of Hydrology ,166,171-191 P.

Bayarı, C.S., Kurttaş, T., 2000. Türkiye Gölleri Hidrojeolojik, Hidrojeokimyasal, Jeokimyasal ve Çevresel İzotopik İncelenmesi Pilot Projesi Köyceğiz Gölü.

Çağatay, M.N., Güngör, N., Yılmaz, Y.Z., Sarı E., 2005. Rapid changes in the ecological conditions of the Black Sea over the last 3kyr: Evidence from sediment geochemistry. In: Özerler, M. and Sayın, E. (eds.), The Role of Marine Studies in Ecosystems, ECOSYSTEM 2003, Izmir, Turkey, pp.85-96.

Cohen, J. L., 2003. Introducing sub-seasonal and temporal resolution to winter climate prediction, Geophys. Res. Lett., 30(4), 1191.

Croudace, I. W., Rindby, A., Rothwell, R. G., 2006. ITRAX: description and evaluation of a new multi-function X-ray core scanner. In: Rothwell, R.G. (ed.) New Techniques in Sediment Core Analysis. Geological Society, London, Special Publications, 267, 51–63.

Croudace, I.W., Rindby, A. and Rothwell, R.G. (2006) ITRAX: description and evaluation of a new multi-function X-ray core scanner. In, Rothwell, R.G. (ed.) new techniques in sediment core analysis. London, UK, Geological Society of London, 51-63. (Geological Society Special Publication 267).

Doğu, A.F. 1988. Köyceğiz-Dalaman Çevresindeki Tarihi Yerleşme Alanlarının Jeomorfolojik Birimlerle İlişkisi (Güneybatı Anadolu). Ankara Üniversitesi, Dil ve Tarih-Coğrafya Fakültesi Dergisi, 32, 1-2, 319-328.

Eroglu, A. 2015. Jeotermal Enerji Sempozyumu.

Francus,P., H. Lamb, T. Nakagawa, M. Marshall, E. Brown.,2006. The potential of high-resolution X-ray fluorescence core scanning: Applications in paleolimnology.

Germade I.R., B. Rubio, D. Rey. 2014. XRF scanners as a quick screening tool for detecting toxic pollutant elements in sediments from Marín harbour in the Ría de Pontevedra (NW Spain). Marine Pollution Bulletin 86 (2014) 458–467.

Güner, N., 1997. Köyceğiz Gölü Havzasının Hidrojeoloji İncelenmesi, Yüksek Mühendislik Tezi, HÜ Fen Bilimleri Enstitüsü, Ankara, 91s.

Haeri, A. 2010. Chemical Analyses of Hot Springs in Sabalan Geothermal Area, NW-Iran, Proceedings World Geothermal Congress 2010.

https://en.wikipedia.org/wiki/Standardization

İkiel, C. 2004. Muğla'nın Coğrafi Özellikleri, Muğla Kitabı (Arkeoloji, Tarih, Coğrafya), Shf; 15-25, İzmir.

Kazancı, N., Plasa, R.H., Neubert, E., İzbırak, A., 1992. On the limnology of Lake Köyceğiz (SW Anatolia). Zoology in the Middle East 6, 109-126.

Krivoruchko, K. 2011. Spatial Statistical Data Analysis for GIS Users. Redlands, CA: Esri Press, 928 pp.

Lloyd, C. 2010. Spatial Data Analysis. 208, 25-34.

Şenel, M., 1997. Türkiye Jeoloji Haritaları Pafta 1, Fethiye., MTA Yayınları.

Şenel, M., 1997a. Geological Map Series of Turkey 1:100 000 scale. No. 1, Geologic Map of Fethiye L7 Quadrangle. General Directorate of Mineral Research and Exploration, Geological Research Department, Ankara (in Turkish).

Şenel, M., 1997b. Geological Map Series of Turkey 1:100 000 scale. No. 2, Geologic Map of Fethiye L8 Quadrangle. General Directorate of Mineral Research and Exploration, Geological Research Department, Ankara (in Turkish).

Thompson, J., Croudace, I.W. and Rothwell, R.G., 2006. A geochemical application of the ITRAX scanner to a sediment core containing eastern Mediterranean sapropel units. In: Rothwell, R.G. (ed.) New Techniques in Sediment Core Analysis. Geological Society London, Special Publications, 267, 65–77.

Tuncel-Göçmen, 1973. Köyceğiz-Fethiye Yöresinde Bazı Coğrafi Gözlemler, İst. Ünv. Coğ. Enst. Der. S; 18-19, Shf ; 111-138, İstanbul.

Weltje, G.J., Tjallingii,R., 2008. Calibration of XRF core scanners for quantitative geochemical logging of sediment cores: Theory and application. Earth and Planetary Science Letters 274 (2008) 423–438.

Weltje, G.J., Tjallingii,R., 2008. Calibration of XRF core scanners for quantitative geochemical logging of sediment cores: Theory and application. Earth and Planetary Science Letters 274 (2008) 423–438.

Zuo, R., 2013. ITRAX: A potential tool to explore the physical and chemical properties of mineralized rocks in mineral resource exploration. Journal of Geochemical Exploration 132 (2013) 149–155.

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Languages

Language	Elementary	Intermediate	Excellent
English		X	
Speaking		X	
Understanding			X
Reading			X

APPENDICES

APPENDIX 1

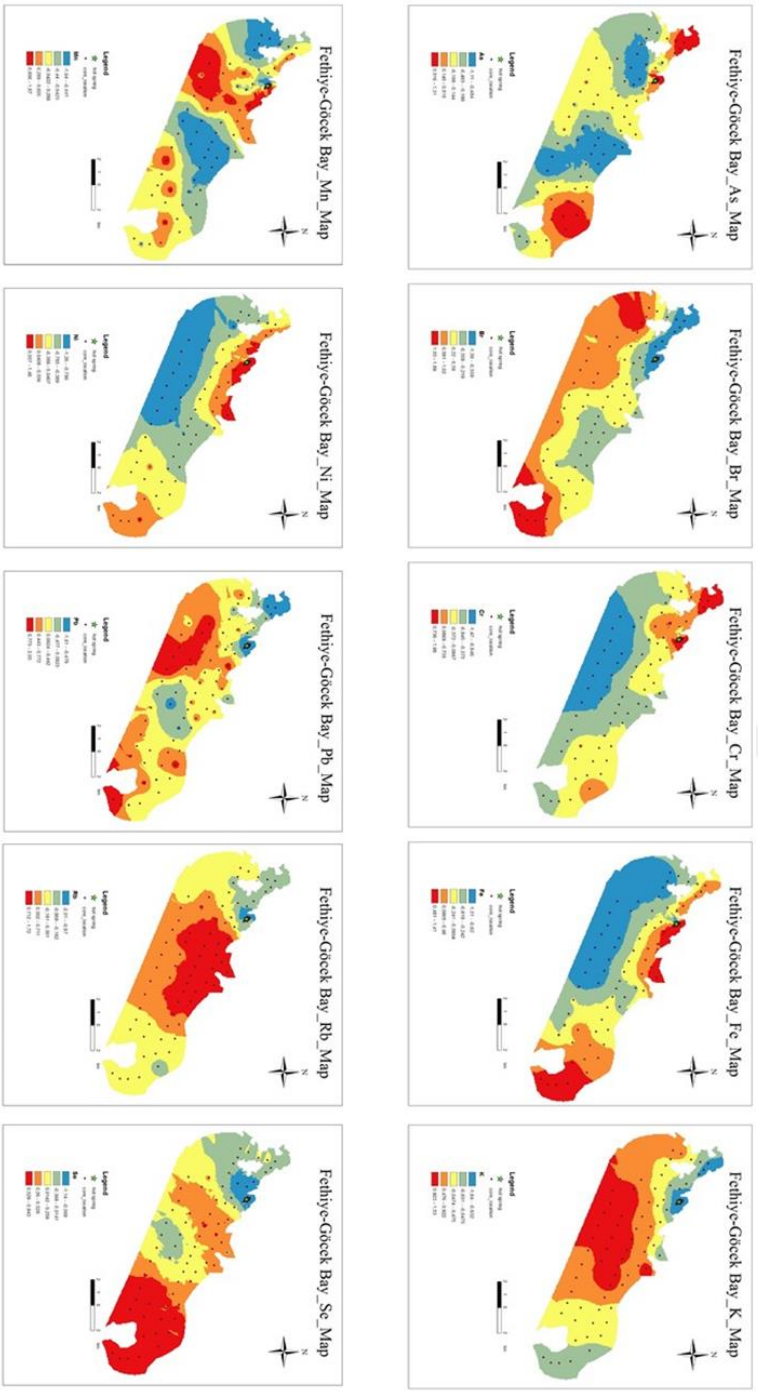

Figure 4.1. Spatial distribution maps of no anomalous elements in Fethiye-Göcek Bay.

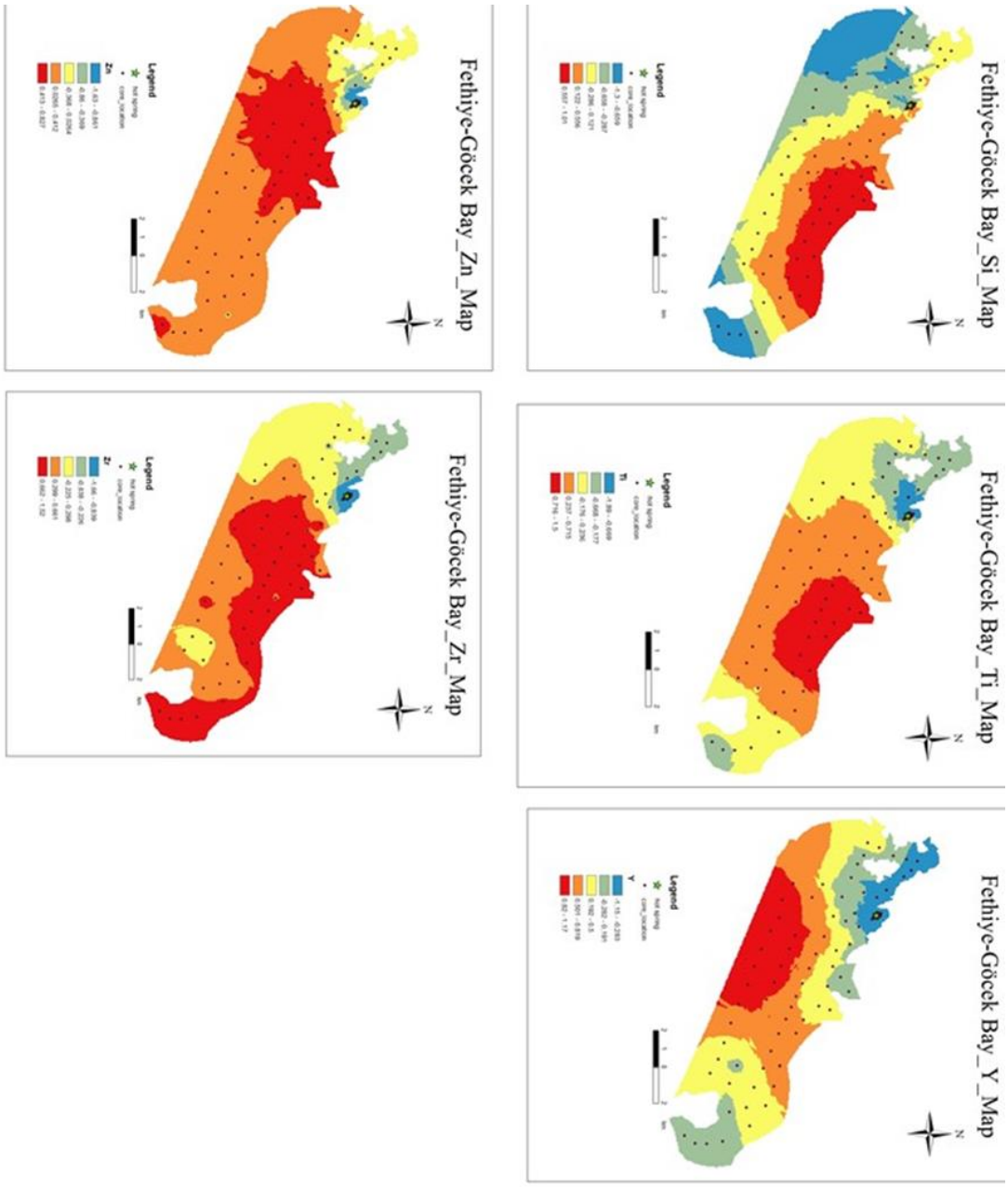

Figure 4.2. Spatial distribution maps of no anomalous elements in Fethiye-Göcek Bay.

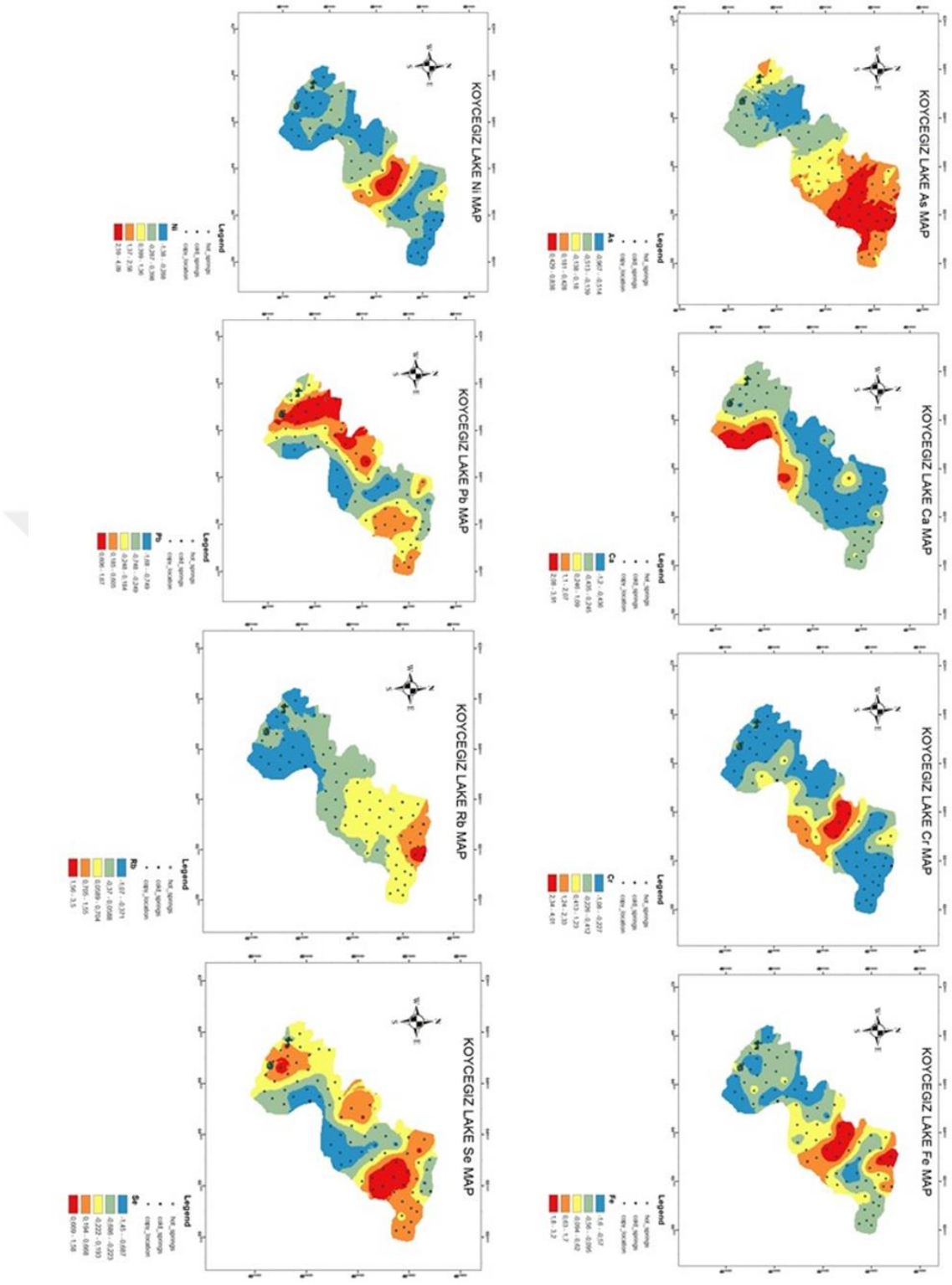

Figure 4.3. Spatial distribution maps of no anomalous elements in Köyceğiz Lake.

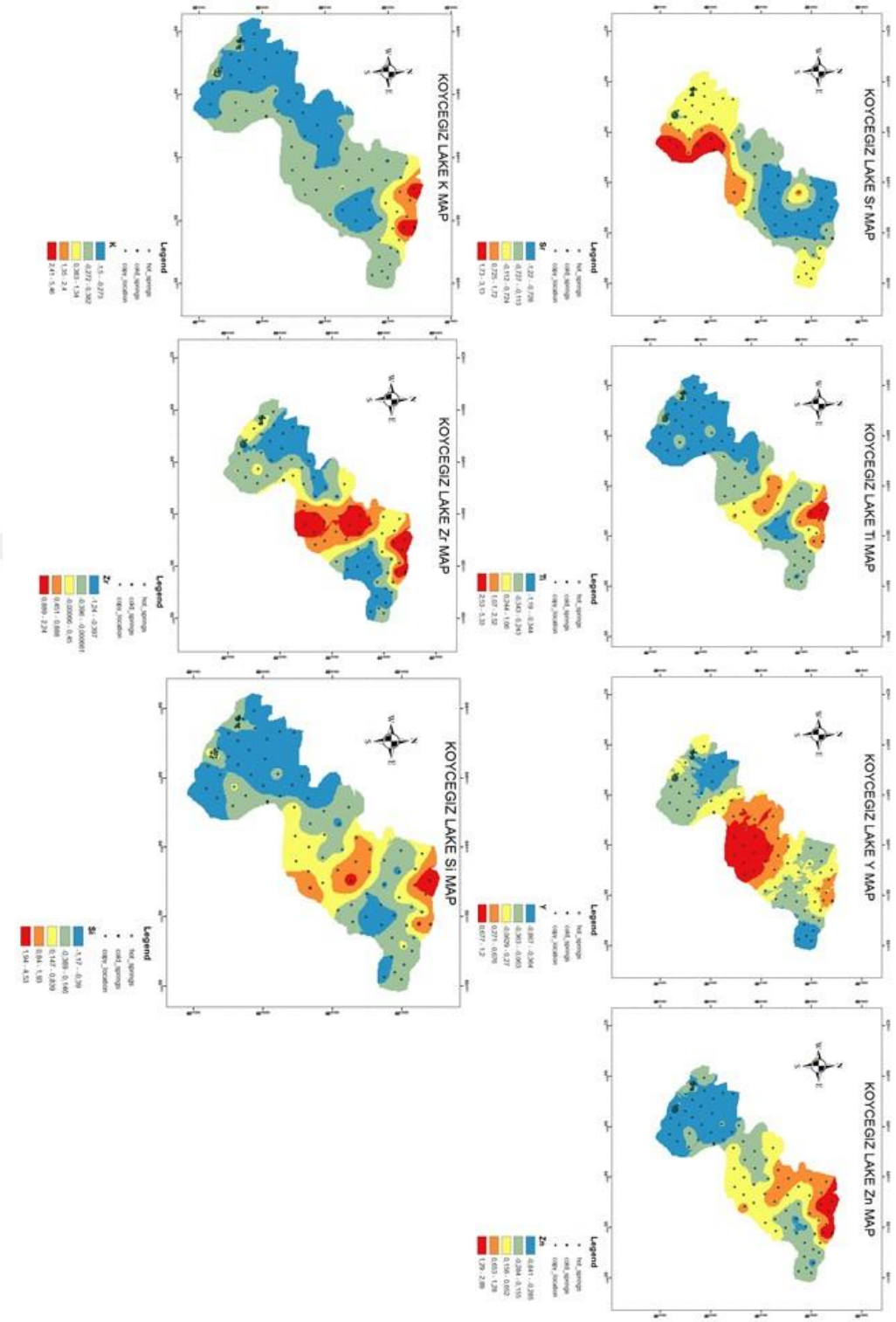

Figure 4.4. Spatial distribution maps of no anomalous elements in Köyceğiz Lake.

APPENDIX 2

Table 4.1. Köyceğiz micro-XRF core scanner results.

	ID	X	Y	kcps	Si	S	Cl	K	Ca	Ti	Cr	Mn	Fe	Ni	Zn	As	Se	Br	Rb	Sr	Y	Zr	Pb
1	K-9	642097	4083621	-0,74	-0,63	0,43	0,96	-0,65	-0,12	-0,74	-0,62	-0,8	-0,77	-0,55	0,41	1,52	0,34	0,17	-1,05	0,35	1,09	-0,26	-0,53
2	K-40	642452	4083142	-0,75	-0,6	-0,24	1,16	-0,94	-0,58	-0,72	-0,71	-0,73	-0,67	-0,53	-0,06	0,64	-0,83	0,38	-0,36	-0,16	1,52	0,42	-0,62
3	K-015-648	642433	4082872	-0,21	-0,63	-0,84	1,24	0,1	0,59	-0,12	-0,36	-0,31	-0,22	-0,03	-0,35	0,59	-0,98	2,77	-0,44	0,93	0,42	-0,38	-0,64
4	K-015-647	642325	4082985	0,32	-0,06	-0,17	0,79	-0,4	-0,32	-0,35	-0,36	-0,62	-0,35	-0,3	-1,06	-0,39	0,47	0,82	-0,65	-0,35	-0,41	-0,12	0,54
5	K-015-646	642370	4082945	-0,43	-0,06	2,17	1,29	0,31	0,3	0,14	-0,18	-0,48	0	0,11	-0,64	0,53	-0,18	0,73	-0,4	0,43	-0,43	-0,09	0,68
6	K-015-645	642428	4083010	-0,46	-0,52	1,1	0,85	-0,32	0,09	-0,4	-0,52	-0,71	-0,52	-0,33	-1,06	0,44	0,08	0,21	0,22	0,36	-0,03	-0,34	-0,71
7	K-015-644	642424	4082965	-0,29	-0,34	1,3	0,69	-0,22	-0,19	-0,37	-0,55	-0,67	-0,39	-0,22	-0,37	-0,94	-1,08	0,35	-0,37	0,04	-1,13	0,17	0,32
8	K-015-643	642514	4082948	-0,71	-0,22	0,5	0,38	-0,47	-0,05	-0,38	-0,51	-0,72	-0,51	-0,35	-0,55	-0,81	0,02	0,32	-0,04	0,1	1,11	-0,56	-0,26
9	K-015-642	642461	4082929	-0,36	-0,2	1,97	0,8	-0,24	-0,24	-0,16	-0,33	-0,59	-0,15	-0,06	-0,98	1,31	-0,29	0,57	0,25	-0,41	0,9	-1,27	-1,72
10	K-015-641	642446	4082822	-1,2	-0,36	-1,37	0,87	0,15	0,69	-0,2	-0,42	-0,29	-0,35	-0,24	-0,18	0,11	-0,87	3,4	-0,34	0,94	0,13	-0,39	-0,46
11	K-015-639	642450	4082891	-1,2	0,05	1,97	0,6	-0,07	0,68	-0,27	-0,32	-0,5	-0,35	-0,24	-0,29	-0,48	-1,16	0,6	-0,25	0,79	0,21	-0,56	-0,59
12	K-015-638	642491	4082865	-1,12	-0,22	1,37	0,47	0,06	0,2	-0,07	-0,2	-0,36	-0,17	-0,11	-0,03	-0,15	-0,74	0,54	-0,24	0,15	-1,47	-0,65	-0,96
13	K-015-000	642409	4082916	-1,95	0,52	1,93	0,5	0,74	0,95	0,13	-0,02	-0,09	-0,1	-0,08	0,25	0,18	-1,53	0,4	-0,16	0,58	0,02	0,06	-1,22
14	K-T-3-635	642694	4082932	0,99	0,7	2,7	1,71	0,31	0,6	0,12	-0,06	-0,51	0,41	0,54	-0,04	0,2	-0,57	0,42	-0,12	0,61	-0,98	-0,27	-0,33
15	K-T-3-634	642663	4082973	1,24	-0,1	0,93	1,28	0,04	0,05	-0,05	-0,17	-0,54	0,08	0,07	-0,15	-0,37	0,18	0,56	0,04	-0,01	-1,37	1,4	1,02
16	K-T-3-633	642804	4082807	1,21	0,24	0,43	1,06	-0,09	-0,14	-0,18	-0,09	-0,53	0,19	0,22	-0,32	-0,18	2,84	1,12	-0,08	-0,2	-0,82	0,12	0,57
17	K-T-3-632	642764	4082855	0,18	-0,33	1,1	1,44	0,22	1,01	-0,2	-0,22	-0,36	-0,27	-0,02	0,38	0,24	0,58	0,82	-0,72	0,78	0,09	0,73	0,27
18	K-T-3-631	642795	4082968	0,59	-0,25	0,37	1,16	-0,22	0,04	-0,23	-0,21	-0,6	-0,23	-0,12	-0,26	0,06	1,3	0,69	-0,54	0,09	-1,47	1,03	-0,3
19	K-T-3-630	642763	4082920	0,58	-0,09	1,1	1,17	-0,04	-0,07	-0,2	-0,21	-0,63	0,03	0,04	-0,83	-1,25	0,41	0,44	-0,34	0	-0,94	-0,23	0,22
20	K-T-3-000	642725	4082889	0,11	0,05	1,37	0,74	0,55	0,24	0,24	0,02	-0,14	0,14	0,2	-0,04	0,68	-0,29	0,23	0,37	-0,07	-0,6	-0,66	0,31
21	K-39	643071	4082508	-0,17	-0,71	0	1,33	-0,56	-0,02	-0,66	-0,61	-0,37	-0,52	-0,51	-0,11	0,85	-0,46	0,6	-1,3	0,6	1,41	0,49	-0,63
22	K-37	643718	4082070	-0,57	-1,03	-0,9	1,43	-0,64	0,49	-0,7	-0,67	-0,7	-0,81	-0,73	0,44	2,2	0,67	0,02	-1,16	0,63	1,7	1,47	-1,39
23	K-R-621Y	643940	4081750	-0,45	1,03	3,04	0,73	1,18	0,59	0,57	0,39	0,25	0,38	0,18	0,51	-0,66	-1,33	0,34	0,61	-0,22	0,22	0,08	0,11
24	K-R-620	643987	4082011	1,32	0,98	-0,07	1,34	-0,05	-0,51	-0,33	-0,29	-0,57	-0,21	-0,24	-0,39	-0,78	0,46	1,1	0,16	-0,41	-1,35	-1,1	0,73
25	K-R-619	643861	4081923	0,77	-0,17	-0,1	1,48	-0,11	0,19	-0,36	-0,44	-0,59	-0,35	-0,39	-1	-1,03	-0,55	0,42	-0,07	0,59	0,03	-0,56	0,84
26	K-R-618	644120	4081843	0,88	0,18	-0,57	1,26	-0,01	-0,61	-0,19	-0,17	-0,52	-0,06	-0,14	-0,99	-1,47	0,26	1,58	0,12	-0,46	-0,11	-0,55	0,07
27	K-R-617	644065	4081747	0,95	0,05	0,97	1,14	0,14	-0,35	0,07	-0,21	-0,54	0,07	0,1	-1,06	-0,05	-0,28	0,64	0,2	-0,43	-0,6	0,19	0,5
28	K-R-028	643751	4081904	1,45	0,22	0,23	1,68	-0,11	-0,56	-0,37	-0,36	-0,64	-0,36	-0,38	-0,9	-0,87	1,48	0,83	0,14	-0,48	-1,01	-0,77	1,54
29	K-R-027	643975	4081886	1,31	-0,22	0,33	1,39	-0,58	-0,59	-0,31	-0,44	-0,66	-0,44	-0,41	-0,8	1,72	1,29	0,89	-0,45	-0,47	1,33	-0,13	0,29
30	K-R-026	644100	4081976	1,16	0,34	-0,3	1,17	0,04	-0,42	-0,01	-0,23	-0,55	-0,16	-0,09	-0,88	0,59	0,26	1,39	0,04	-0,24	-1,47	-0,77	1,05
31	K-R-024	643871	4082002	0,89	0,07	0,77	0,85	-0,24	-0,51	-0,3	-0,3	-0,56	-0,21	-0,16	-0,8	-1,93	-0,02	0,94	-0,17	-0,31	0,01	-0,22	1,76
32	K-42	644494	4081634	-0,39	-0,86	-0,2	0,89	-0,73	0,17	-0,68	-0,74	-0,71	-0,87	-0,73	-0,33	-0,77	0,31	0,91	-0,42	0,87	-0,49	-0,57	1,22
33	K-7	642862	4083653	-0,11	-0,33	1,43	1,75	-0,44	0,11	-0,55	-0,5	-0,69	-0,26	-0,25	-0,64	-0,73	-0,16	0,9	-0,34	0,6	-0,9	-0,98	0,97
34	K-38	643387	4082903	0,26	-1,1	-1,24	1,01	-0,85	-0,5	-0,83	-0,76	-0,82	-0,91	-0,75	-1,06	-1,14	0,59	0,35	-0,42	0,25	0,07	-0,48	1,14
35	K-36	644081	4082513	0,65	-0,61	-1,77	0,87	-0,8	-0,68	-0,65	-0,42	-0,68	-0,7	-0,61	-0,6	-0,85	1,96	1,27	-0,05	-0,35	-1,47	-0,56	1,39
36	K-43	644872	4082142	-0,5	-0,57	-0,77	0,75	-0,31	0,45	-0,44	-0,33	-0,56	-0,36	-0,24	-0,29	-0,22	0,37	0,76	-0,21	0,64	1,21	-0,35	-0,39
37	K-66	645460	4081551	-1,83	-0,95	-0,54	0,69	-0,4	1,69	-0,75	-0,47	-0,6	-0,9	-0,65	-0,86	-0,85	-0,32	1,39	-1,06	2,22	-0,27	0,27	0,07
38	K-65	645875	4082013	-1,95	-1,17	-2,17	0,83	-0,39	3,28	-0,82	-0,29	0,03	-1,04	-0,92	-0,69	0,63	-0,77	0,54	-0,91	3,45	-0,51	-0,51	-1,21
39	K-44	645379	4082750	-0,4	0,64	1,1	-0,04	0,62	0,32	0	0,06	-0,38	0,3	0,28	0,37	-0,92	-0,54	0,11	-0,47	0,08	-0,7	0,92	0,02
40	K-35	644430	4082925	-0,08	-0,87	-0,37	0,74	-0,74	-0,03	-0,63	-0,52	-0,75	-0,62	-0,53	-0,38	-1,03	0,47	0,9	-0,57	0,46	-0,17	-0,07	1,18
41	K-10	643798	4083413	-0,18	-0,95	-0,03	1,11	-0,69	-0,29	-0,66	-0,6	-0,76	-0,44	-0,32	-0,42	-1,93	0,36	1,15	-0,27	-0,15	-0,7	-1,63	2,25
42	K-6	643321	4084181	0,01	-0,64	0,37	1,39	-0,47	-0,03	-0,46	-0,45	-0,68	-0,39	-0,3	-0,81	-0,8	0,29	0,86	-0,18	0,53	-0,55	-1,05	0,99
43	K-41	642996	4084726	0,34	-0,84	0,57	1,4	-0,5	-0,35	-0,52	-0,23	-0,68	-0,04	0,09	-0,48	-0,1	-0,01	0,67	-0,61	-0,02	-1,47	-0,45	0,25
44	K-8	643029	4085344	0,01	-1,03	-1	0,91	-0,82	0,16	-0,77	-0,32	-0,8	-0,67	-0,48	-0,93	-1,35	-0,01	0,8	0,19	0,56	-0,78	-0,88	1,72
45	K-11	644188	4084101	-0,06	-0,68	0,23	0,68	-0,65	-0,15	-0,51	-0,47	-0,69	-0,38	-0,26	-0,83	-0,91	0,61	0,48	-0,48	0,25	-1,43	-0,8	0,95
46	K-34	644873	4083484	-0,35	-0,79	0,1	0,47	-0,32	0,58	-0,51	-0,37	-0,64	-0,35	-0,22	-0,83	-0,28	-0,15	0,29	-0,75	0,87	-0,43	-0,73	-0,09
47	K-45	645775	4083244	-2,42	-0,22	-2,04	0,27	-0,02	4,4	-0,61	1,08	0,05	-0,84	-0,66	-0,21	-0,31	-1,65	-0,15	-1,32	2,59	0,36	-0,52	-1,01
48	K-64	646220	4082702	-1,19	0,02	1,17	0,11	0,12	1,9	-0,35	0,09	-0,26	-0,42	-0,2	-0,09	0,55	-0,18	-0,31	-0,66	1,18	0,11	-0,06	-1,72
49	K-33	645333	4084028	-1,55	-0,66	-1,3	-0,02	-0,18	2,96	-0,64	-0,08	-0,34	-0,78	-0,48	-0,93	-0,28	-1,32	1,49	-1,13	3,4	0,5	-0,35	-0,64

Table 4.1. (continues)

	ID	X	Y	kcps	Si	S	Cl	K	Ca	Ti	Cr	Mn	Fe	Ni	Zn	As	Se	Br	Rb	Sr	Y	Zr	Pb
51	K-32	645786	4084749	-0,86	-0,52	-0,84	-0,37	-0,17	1,87	-0,49	-0,33	-0,34	-0,54	-0,3	-0,86	-0,99	-1,24	1,54	-0,34	2,89	-0,76	0,82	-0,05
52	K-13	645320	4085261	-3,77	-1,33	-0,34	-2,13	-1,74	-1,38	-1,26	-1,17	-0,98	-1,67	-1,48	-0,77	-1,93	-0,1	-0,9	-0,06	-0,68	1,63	0,23	1,24
53	K-5	644934	4085676	-1,01	-0,9	-0,37	-1,33	-1,04	-0,83	-0,9	-0,88	-0,76	-1	-0,96	-0,03	-1,3	0,28	-1,03	-0,13	-0,13	0,11	-1,05	0,18
54	K-14	645876	4085956	-3,4	-1,25	-1,04	-1,86	-1,61	-1,35	-1,22	-1,07	-0,9	-1,52	-1,35	-0,41	-1,93	0,3	-1,07	0,34	-1,16	1,84	-0,85	2,41
55	K-31	646267	4085354	-0,12	1,15	-0,64	-0,96	0,27	0,67	0,44	1,25	1,91	0,46	0,6	1,51	0,39	-0,91	0,35	-0,61	0,11	0,95	0,03	-0,89
56	K-46	647507	4085404	-1,02	0,21	-1,44	-0,69	0,17	0,68	0,03	0,16	1,18	0,18	0,17	0,91	2,17	-1,13	0,13	-0,53	0,74	0,7	1,22	-2,54
57	K-30	646970	4086044	1,11	-0,28	-0,5	-0,86	-0,49	-0,69	-0,33	-0,35	-0,34	-0,39	-0,39	-0,53	-0,09	1,38	-1,12	-0,25	-0,85	-0,74	-1,63	0,22
58	K-15	646450	4086636	0,75	-0,25	0,43	-0,27	-0,15	-0,69	-0,2	-0,46	-0,35	-0,15	-0,32	0,07	1,34	0,72	-0,58	0,12	-0,45	0,2	-0,7	-0,06
59	K-3	646262	4087710	0,76	0,07	0,03	-0,48	-0,08	-0,03	-0,16	-0,31	-0,49	-0,07	-0,09	0,72	0,2	0,32	-1,17	-0,66	0,05	-0,02	0,77	-0,17
60	K-16	646992	4087300	0,54	-0,87	-0,9	-0,98	-1,11	-1,02	-0,82	-0,54	-0,63	-0,98	-0,73	-0,53	-0,78	1,76	-0,64	0,14	-0,95	0,45	-1,63	2,35
61	K-29	647464	4086657	0,54	0,38	-0,1	-0,8	-0,22	-0,29	-0,09	0,21	0,45	0,26	0,26	0	-0,62	-0,42	-0,34	0,49	-0,42	1,57	1,17	0,6
62	K-47	648001	4086000	-1,43	0,53	0,1	-0,95	0,18	1,63	-0,02	1,06	0,62	-0,06	0,26	0,5	-0,17	-1,59	0,59	-0,24	1,5	1,54	1,42	-1,19
63	K-63	648601	4085443	-1,75	0,33	-1,34	-1,06	-0,18	3	-0,32	1,75	0,43	-0,39	-0,22	-0,12	0,7	-1,54	-0,59	-0,83	2,15	1,61	1,58	-1,92
64	K-62	649048	4085973	-1,64	0,91	-0,64	-1,08	0,2	0,86	0,34	1,85	1,54	0,54	0,79	0,47	-0,37	-2	-0,42	-0,39	0,68	0,34	1,16	-1,07
65	K-48	648447	4086580	0,47	-0,36	-0,4	-1,12	-0,45	-0,58	-0,1	0,03	0,55	0,12	0,35	-0,14	-0,26	0,16	1,47	-0,23	-0,52	2,51	0,91	-0,46
66	K-67	649761	4086044	0,05	2,53	0,17	-1,2	0,56	-0,02	1,33	2,23	1,72	1,93	2,77	1,23	1,08	-0,7	-1,1	-0,11	-0,27	1,19	0,56	-0,94
67	K-61	649544	4086587	0,85	-0,11	-0,3	-0,67	-0,1	-0,44	0,13	0,13	3,57	0,64	0,62	-0,03	-1,93	-1,31	1,61	0,7	-0,51	1,72	0,97	0,08
68	K-49	648992	4087228	0,38	1,26	-0,24	-1,03	0,23	-0,91	1,5	3,38	3,45	3	4,26	0,78	1,54	-1,11	-1,7	0,67	-1,3	-0,31	0,32	-1,33
69	K-28	648103	4087422	1,38	-0,33	0,43	-0,66	-0,86	-0,9	-0,42	-0,26	-0,34	-0,22	0,11	-0,97	-1,53	-0,06	-1,24	0,86	-1,11	2,23	0,89	0,98
70	K-17	647583	4088032	0,57	1,24	0,23	-0,88	0,29	-0,88	1,63	3,77	0,17	2,77	2,99	1,99	0,81	-0,87	-1,78	0,51	-1,26	-0,31	1,3	-0,89
71	K-18	648079	4088632	1,18	1,21	0,83	-0,71	0,37	-0,94	1,57	2,73	0,28	2,82	2,79	1,83	0,42	-0,61	-1,51	0,85	-1,27	1,07	1,68	-1,26
72	K-27	648616	4088021	0,49	1,48	-0,57	-1,07	0,11	-0,88	1,39	4,16	1,62	2,98	4,15	1,67	0,06	-1,5	-1,85	-0,02	-1,29	-1,25	1,31	-1,55
73	K-50	649472	4087826	0,44	3,53	-0,37	-1,34	0,72	-0,72	2,07	3,16	1,49	2,99	4,05	1,92	1,49	-0,68	-1,96	0,87	-1,26	1,16	1,32	-1,64
74	K-68	650723	4087255	-0,54	0,01	-1,94	-0,9	-0,09	0,29	0,34	1,53	3,61	0,56	0,61	0,89	0,53	-0,44	0,13	-0,73	-0,59	-1,07	-0,35	-0,29
75	K-59	650504	4087831	1,28	-0,44	-0,84	-0,78	-0,88	-0,89	-0,52	-0,6	-0,28	-0,59	-0,45	-0,65	-0,18	1,92	-0,27	0,25	-0,99	0,72	-0,66	0,89
76	K-51	650001	4088492	1,07	-0,75	-1,14	-0,61	-0,89	-0,91	-0,71	-0,7	-0,7	-0,91	-0,78	-0,41	0,72	0,93	-1,04	0	-1,03	0,42	-0,59	1,05
77	K-26	649064	4088587	0,84	1,18	2	-1,05	0,5	0,01	0,86	1,22	0,85	1,29	1,37	0,56	0,74	0,18	-0,78	0,94	0,05	0,06	2,29	-1,08
78	K-19	648575	4089249	-0,69	-0,22	0,57	-0,49	0,04	2,14	-0,12	0,72	0,48	0	0,4	-0,01	0,07	-2,15	-0,35	-0,39	2,12	0	1,24	-1,23
79	K-2	648150	4089979	0,49	-0,44	-0,37	-0,44	-0,47	-0,95	-0,17	-0,4	-0,25	-0,37	-0,36	0,41	1,4	0,58	-0,6	-0,53	-0,89	-1,47	-0,19	-0,66
80	K-20	649088	4089900	0,7	-0,76	-0,57	-0,58	-0,44	-0,39	-0,37	-0,68	-0,59	-0,55	-0,65	0,01	0,83	0,38	-0,8	-0,42	-0,37	0,34	0,02	-0,72
81	K-25	649609	4089254	0,95	-0,71	-0,84	-0,48	-0,7	-0,67	-0,66	-0,72	-0,73	-0,92	-0,81	-0,74	0,83	1,99	-0,36	-0,14	-0,9	0,18	-1,63	0,43
82	K-52	650482	4089108	1,15	-0,38	-0,9	-0,39	-0,67	-0,91	-0,66	-0,78	-0,61	-0,87	-0,7	-0,91	-0,64	2,03	-0,38	-0,69	-1,11	-0,76	-1,44	0,91
83	K-58	651018	4088464	0,71	-0,49	-0,9	-0,34	-0,63	-0,85	-0,52	-0,59	-0,42	-0,66	-0,53	0,09	1,12	1,82	-0,43	-0,32	-0,91	-0,96	-0,86	0,27
84	K-69	651220	4087886	0,53	-0,33	-0,03	-0,63	-0,17	-0,6	0,21	0,03	2,38	0,56	0,36	0,9	1,05	1,14	0,42	0,38	-0,81	-0,41	-0,44	0,31
85	K-57	651356	4089125	0,85	-0,75	-0,77	-0,59	-0,46	-0,64	-0,27	-0,5	-0,41	-0,25	-0,21	-0,55	0,48	0,09	-0,62	-0,25	-0,57	-0,87	-1,08	0,43
86	K-24	650173	4089890	0,23	0,67	0,97	-0,71	1,56	-1,16	2,51	0,29	0,16	1,85	0,45	1,95	1,78	0,89	-1,21	2	-1,3	-0,37	1,21	-0,53
87	K-53	650932	4089676	0,96	-0,76	-0,44	-0,39	-0,69	-0,9	-0,52	-0,6	-0,57	-0,67	-0,33	-1,06	0,07	1,15	-0,63	0,14	-1,11	-0,52	-0,89	0,77
88	K-56	651919	4089598	0,38	0,21	1,03	-0,91	0,58	-0,08	0,31	-0,28	-0,03	0,21	0,06	0,43	0,72	0,1	-0,53	0,18	0,03	1,19	0,15	-0,53
89	K-70	652739	4089574	-0,15	-0,52	-0,74	-1,18	0,3	0,23	-0,01	-0,52	0,08	-0,26	-0,49	-0,24	1,25	-0,42	-0,71	-0,21	0,51	-0,67	-0,62	-0,17
90	K-74	653614	4089248	0,16	-0,47	-0,03	-1,01	0,08	-0,05	-0,3	-0,44	0,41	-0,42	-0,45	-0,35	-0,77	0,13	-0,52	0,31	-0,12	-0,41	-0,74	0,73
91	K-73	653410	4089703	0,34	-0,36	-0,14	-0,97	-0,07	0,6	-0,42	-0,57	0,23	-0,46	-0,53	-0,17	-0,4	0,4	-0,57	-0,1	0,69	-1,47	-0,1	-0,48
92	K-55	652306	4090116	0,53	0,59	0,93	-0,98	0,15	-0,64	-0,13	-0,45	0,74	-0,12	-0,25	-0,1	1,25	1,04	-0,71	0,25	-0,66	-0,67	-0,94	0,4
93	K-54	651381	4090220	0,63	0,02	0,3	-0,9	0,49	-0,53	0	-0,47	-0,21	-0,2	-0,32	-0,86	1,1	-0,07	-0,9	0,05	-0,87	-0,41	-1,15	0,52
94	K-23	650589	4090434	0,72	-0,4	-1,17	-0,4	0,05	-0,49	-0,05	-0,49	-0,54	-0,16	-0,23	-0,35	-0,56	1,66	-0,64	0,38	-1,03	0,55	-1,35	1,17
95	K-21	649632	4090562	-0,44	2,22	-0,84	-1,11	2,73	-1,06	4,09	1,02	0,7	2,84	0,71	3,08	1,16	-0,69	-1,71	1,66	-1,27	0,32	2,05	-0,96
96	K-1	648955	4090607	0,7	-0,17	-0,37	-0,51	-0,37	-1,02	0,01	-0,56	-0,51	-0,41	-0,73	0,52	-0,29	1,8	-0,74	-0,51	-1,16	-1,33	-0,79	1,29
97	K-22	648280	4090888	0,35	0,16	0,1	-0,9	0,24	-1,03	0,38	-0,34	0,49	0,18	-0,31	1,14	-1,29	0,93	-0,72	0,45	-1,17	-0,19	-0,28	1,05
98	K-75	649456	4091218	-0,28	5,16	0,6	-1,15	3,85	-0,91	5,62	1,35	1,11	3,39	1,25	3,35	0,54	-0,99	-1,95	2,6	-1,25	0,93	3,24	-1,82
99	K-76	650035	4091048	-0,33	1,72	0,43	-0,15	2,11	-0,82	1,81	0,28	0,4	1,47	0,32	1,46	-0,53	-0,73	-0,95	1,42	-1,12	0,71	1,6	-0,52
100	K-77	650813	4090888	-0,49	-0,52	0,1	0,87	0,85	1,14	0,3	-0,53	-0,18	-0,03	-0,38	0,72	-1,4	-1,93	-0,56	0,62	0,28	0,01	0,29	-0,8
101	K-78	651312	4090737	0,22	3,21	-0,7	-1,51	6,84	-1,12	3,17	-0,44	4,08	2,04	-1,14	4,96	1,82	-0,76	-1,57	7,86	-1,29	1,39	3,11	-0,46
102	K-79	651919	4090534	-0,22	-0,55	-1,1	-1,2	0,6	0,28	-0,36	-0,74	0,14	-0,77	-0,95	0,23	2,26	0,13	-1,32	-0,79	0,62	2,53	1,38	-1,08
103	K-80	652488	4090455	0,89	-0,41	-1,04	-1,43	0,07	-0,04	-0,38	-0,78	0,61	-0,51	-0,71	-0,56	-0,2	1	-0,29	0,22	-0,08	-1,35	-0,71	0,31
104	K-71	653093	4090108	0,86	-0,28	-0,03	-1,06	0,11	-0,18	-0,37	-0,63	0,44	-0,39	-0,48	-0,64	-0,45	0,26	-1,15	0,38	0,31	-1,12	-1,01	0,65
105	K-72	653719	4089989	0,66	-0,2	0,17	-1,3	-0,07	-0,29	-0,22	-0,5	0,57	-0,3	-0,46	-0,29	-0,81	0,19	-0,58	0,69	-0,26	-0,52	-0,14	1,09

Table 4.2. Fethiye - Göcek micro-XRF core scanner results.

ID	X	Y	kcps	Si	S	Cl	K	Ca	Ti	Cr	Mn	Fe	Ni	Zn	As	Se	Br	Rb	Sr	Y	Zr	Pb
I-100	675787	4066071	-1,4	-2,01	1,63	3,45	-0,98	3,1	-2,17	-0,58	-2,57	-2,56	-1,59	-2,61	-0,52	-0,69	-0,91	-2,58	3,65	-0,84	-1,13	-1,6
I-103	675803	4066045	-1,9	-2,26	3,7	2,47	-1,03	3,33	-2,09	-1,21	-2,39	-2,65	-1,72	-1,91	-1,17	-0,74	-0,58	-2,63	3,28	-1,97	-0,52	-1,25
I-123	675819	4066069	-2,03	-3,08	3,21	1,08	-1,51	5,5	-3,16	-1,15	-2,79	-3,29	-1,85	-3,51	-0,46	-2,96	-1,98	-3,06	4,11	0,65	-1,72	-1,67
I-106	675722	4066166	-2,38	-3,33	1,39	3,03	-1,78	3,43	-3,24	-0,88	-2,77	-2,45	-1,35	-2,8	-0,1	-0,06	-1,68	-2,68	1,86	-0,7	-1,56	-0,44
I-122	675744	4066234	-0,53	-0,65	1,63	0,02	-2,17	-0,21	-3,15	0,35	-1,08	1,1	2,95	-3,05	3,2	-3,41	-2,65	-1,68	-0,07	-1,76	-2,72	-2,1
I-107	675770	4066297	0,46	-1,84	1,75	1,36	-2,43	0,94	-3,36	0,11	-0,47	0,03	1,22	-2,92	1,73	0,19	-1,67	-2,32	0,7	-1,19	-2,16	-1,5
I-111	675811	4066096	-1,1	-0,12	0,54	0,07	-0,32	0,16	-0,26	-0,31	-0,76	-0,51	-0,16	-0,24	-0,21	-1,19	0,35	-0,58	1,83	-0,52	-0,36	-0,44
I-126	675848	4066058	-0,11	-0,59	0,66	0,36	-0,16	0,27	-0,17	-0,38	-0,73	-0,6	-0,34	0,7	0,3	-1,19	1,52	-0,84	2,99	-1,1	-0,14	-1,33
I-114	675878	4066055	-0,42	0,87	-0,31	-0,86	-0,81	0,44	-0,55	1,01	-0,22	0,07	0,47	-0,53	0,05	-0,74	-0,79	-1,36	1,89	-0,73	-0,61	-0,29
I-125	675868	4066089	-0,08	0,56	0,9	-0,99	-1,01	0,13	-0,37	1,19	0,16	0,3	0,67	-0,54	-1,23	-1,17	-1,02	-1,15	1,66	-0,71	-1,58	-0,23
I-112	675863	4066127	-0,24	0,56	0,17	-1,05	-1,1	0,36	-0,82	1,45	0,43	0,54	0,89	-0,78	0,18	-1,19	-1,27	-0,88	0,83	-1,1	-1,21	-0,54
I-124	675826	4066143	-0,26	0,05	-0,19	-0,3	-1,04	0,13	-0,47	2,07	0,45	0,46	0,82	-0,56	0,84	-0,58	-1,3	-1,27	1,25	-0,64	-1,38	-1,19
I-115	675794	4066195	0,34	1,04	0,36	-1,09	-1,25	-0,14	-0,81	1,57	0,43	1,16	1,4	-0,92	3,62	-0,4	-1,72	-1,4	0,04	-2,41	-1,98	-2,6
I-120	675849	4066189	0,47	1,57	-0,07	-1,46	-1,23	-0,4	-0,48	1,74	0,84	1,2	1,37	-0,09	0,32	-0,33	-1,06	-0,53	-0,17	-0,87	-0,93	-0,9
I-109	675925	4066101	0,46	-0,18	-0,25	0,09	-1,26	-0,64	-0,54	1,43	0,76	1,18	1,28	-0,59	0,25	-0,47	-0,74	-0,51	-0,41	-2,18	-0,93	0,27
I-127	675923	4066051	0,37	0,17	0,05	-1,08	-0,99	-0,54	-0,37	1,36	0,55	1,17	1,33	-0,62	0,59	-0,38	-0,75	-0,19	-0,18	-0,94	-1,33	-0,48
I-135	675938	4066008	1,25	-0,86	-0,56	-0,35	-1,12	-0,41	-0,15	1,77	1,23	1,65	1,68	0,01	1,31	-1,78	-1,14	0,09	-0,25	-0,73	-1,5	0,22
I-110	675968	4066030	0,61	0,05	-0,43	-0,64	-1,18	-0,66	-0,44	1,3	0,59	1,2	1,28	0,01	-0,48	-0,47	-0,92	-0,56	-0,5	-1,51	-0,15	0,22
I-105	675952	4065951	0,63	0,01	1,02	-0,01	-0,92	-0,6	-0,45	1,69	0,36	1	1,21	0,17	0,55	0,94	-0,88	-0,4	-0,25	0,19	-0,88	-0,29
I-121	675987	4066125	0,84	0,42	0,66	-1,2	-0,98	-0,65	0,03	1,32	0,78	1,46	1,51	-0,34	0,66	-0,76	-1,31	0,01	-0,53	-1,33	-1,2	-0,79
I-113	675938	4066182	0,33	0,58	-0,07	-1,53	-1,24	-0,69	-0,31	0,95	0,6	0,99	1,09	-0,21	0,11	-1,37	-0,55	-0,7	-0,53	-0,63	-0,92	-1,06
I-116	675869	4066262	0,57	1,57	-0,74	-1,71	-0,8	-0,6	0,59	1,28	0,73	1,28	1,15	0,25	-0,17	-1,67	-1,09	-0,35	-0,46	0,01	-0,74	-1,04
I-133	675774	4066397	0,73	0,19	0,9	0,16	-1,3	0,05	-0,79	1,13	0,33	1,1	1,35	-1,17	0,81	0,21	-1,26	-1,15	0,53	-2,01	-1,07	-1,06
I-132	675906	4066352	1,05	0,38	0,42	-0,41	-0,95	-0,52	0,59	1,76	1,36	1,6	1,34	0,26	-0,64	0,6	-1,55	-0,16	-0,29	-0,31	-1,04	-0,44
I-131	675971	4066261	1,11	-0,1	-1,35	-1,13	-1,16	-0,71	0,47	1,19	0,87	1,63	1,53	-0,01	0,94	-1,39	-0,96	-0,4	-0,54	-1,46	-1,05	-0,4
I-130	676045	4066186	1,2	-0,16	-0,31	-0,96	-1,28	-0,85	-0,21	1,09	0,62	1,48	1,66	-0,7	0,49	0,05	-0,84	-0,26	-0,63	-0,59	-1,36	-1,83
I-129	676008	4066072	0,55	0,13	0,66	-1	-0,91	-0,77	0,02	1,35	0,46	1,43	1,44	-0,27	-0,06	-0,1	-0,8	-0,18	-0,58	-0,48	-1,22	-0,01
I-128	676052	4065986	0,3	0,01	0,54	-0,95	-1,18	-0,78	-0,51	1,32	0,67	1,31	1,52	-0,43	0,4	0,39	-0,88	-0,16	-0,59	-1,4	-1,32	-0,44
F-70	672579	4065446	-0,37	-1,2	-0,61	1,14	0,51	0,61	-0,31	-0,54	-0,74	-0,84	-0,66	0,03	-0,74	0,31	0,46	-0,08	0,45	-0,87	-0,07	0,49
F-63	673395	4068021	-0,98	0,47	-1,7	-0,41	-0,91	-0,1	-0,65	1,57	0,66	0,33	0,37	0,51	0,88	-1,34	-0,93	-0,76	-0,1	-0,77	-1,05	-0,67
F-64	672902	4068383	-0,17	-0,28	-0,8	-0,02	-0,97	-0,03	-0,11	2,68	0,33	0,67	-0,18	-0,28	2,67	-0,28	-1,23	-0,92	-0,38	-2,04	-0,98	-2,14
F-65	672794	4067762	-1,35	-0,62	-0,21	0,88	-0,44	1,4	-0,61	0,5	-0,67	-0,55	-0,8	-0,88	0,98	1,49	-0,79	-1,25	0,64	0,05	-0,92	-1,18
F-66	672606	4067052	-0,83	-0,57	-0,31	0,62	0,46	0,2	0,13	-0,13	-0,65	-0,63	-0,78	0,72	-0,36	0,23	0,19	0,27	0,03	0,3	0,86	-0,12
F-67	672154	4066275	-0,11	-0,11	-1,1	0,69	0,95	0,08	0,63	-0,23	-0,96	-0,56	-0,8	0,08	-0,91	1,33	0,68	0,8	-0,07	1,29	0,19	0,4
F-69	671900	4065635	-0,29	-0,03	-1	0,29	0,95	0,5	0,36	-0,46	-0,7	-0,73	-0,81	0,84	-0,65	-1,02	0,62	0,41	0,16	1,22	0,28	1,1
F-85	673753	4067631	0,67	0,39	0,78	0,24	-0,78	-0,42	-0,56	0,62	1,01	0,5	1,02	-0,09	0,39	0,04	-0,34	-0,41	-0,35	0,02	-0,16	0,21
F-62	674501	4066666	0,03	0,55	-0,01	-1,03	-0,03	-0,57	0,13	0,11	0,23	0,18	0,54	0,6	-1,13	-1,02	-0,4	0,02	-0,43	-0,46	-0,85	0,34
F-84	674888	4066139	0,72	1,48	0,38	-1,29	-0,55	-0,43	-0,45	-0,29	0,86	0,58	0,96	-0,11	-0,25	-0,24	-0,63	-0,35	-0,33	-0,57	-0,17	0,19
F-61	676075	4065876	0,64	-0,06	1,08	-0,29	-1,42	-0,83	-0,8	1,23	0,51	0,88	1,31	-0,37	0,55	0,64	-0,51	-0,52	-0,6	-0,82	-1,13	-1,08
F-60	674636	4065442	-0,65	-0,65	-1,1	-0,14	-0,13	-0,37	-0,44	1,32	0,01	-0,3	-0,1	1,08	-0,65	0,17	0,44	-0,13	-0,41	0,76	0,44	1,32
F-71	673064	4065097	-1,58	-2,58	2,26	2,15	-0,22	2,56	-1,84	-0,94	-2,4	-2,22	-1,58	-3	-0,14	-1,81	2,99	-1,7	3,27	-0,18	-0,84	-0,84
F-59	673793	4064755	0,04	-0,08	-0,92	-0,3	0,47	-0,18	-0,12	0,07	0,03	-0,36	-0,3	1,08	-0,69	0,3	1,09	0,73	-0,17	-0,09	0,09	-0,05
F-55	674162	4063171	-0,28	-0,94	-0,8	0,12	0,81	-0,27	0,16	-0,99	-0,31	-0,7	-0,92	0,86	-0,44	1,8	1,44	0,8	-0,43	0,26	0,72	2,11
F-54	674871	4064254	-1,6	0,05	0,17	1,19	0,05	-0,2	0,2	1,57	1,75	-0,41	0,16	0,26	-1,19	-1,15	-0,53	-0,28	-0,56	-0,52	-0,49	-0,48
F-53	675750	4064933	-0,66	0,13	-1,29	-0,52	0,65	-0,44	0,47	0,02	0,01	-0,12	-0,2	0,89	-2,14	-0,24	0,53	0,9	-0,5	0,08	1,08	0,6
F-83	676498	4065157	1,21	0,64	0,78	-1,42	-0,51	-0,93	0,53	-0,64	1,07	0,84	0,82	-0,21	-0,18	0,74	-0,25	0,02	-0,62	0,99	-0,2	0,57
F-52	676183	4064459	-1,17	-0,36	-0,68	-0,93	-0,02	-0,58	-0,09	-0,1	-0,82	-0,22	-0,02	0,96	-1,03	0,57	0,5	0,36	-0,55	-0,17	-0,34	-0,36

Table 4.2. (continues)

ID	X	Y	kcps	Si	S	Cl	K	Ca	Ti	Cr	Mn	Fe	Ni	Zn	As	Se	Br	Rb	Sr	Y	Zr	Pb
F-51	675922	4063775	-1,05	-0,06	-0,56	-0,63	1,11	-0,19	0,67	-0,87	-0,81	-0,39	-0,63	1,03	-0,36	-0,26	0,45	0,96	-0,45	0,44	1,01	0,66
F-50	674894	4062595	-1,06	-0,67	-1,71	-0,17	1,13	0,08	0,51	-1,1	0,26	-0,55	-0,94	1,27	0,49	0,12	0,74	1,1	-0,28	0,95	1,01	1,43
F-49	674129	4061555	-0,91	-0,73	-0,74	1,29	0,82	0,69	-0,13	-0,93	2,77	-1,02	-1,11	-0,13	0,65	-0,81	-0,08	-0,55	0,8	0,88	-0,17	-0,25
F-48	675028	4060955	-1,25	-0,36	-1,41	0,46	1,33	0,69	-0,03	-1,45	-0,11	-1,1	-1,35	-0,72	-0,31	0,89	0,45	0,26	0,2	2,03	-0,24	0,53
F-46	677029	4063255	-0,11	0,48	-0,74	-0,01	0,85	-0,12	0,56	-0,54	1,41	-0,15	-0,44	0,97	-0,12	0,39	0,91	0,96	-0,42	0,95	1,11	0,66
F-82	677457	4064661	0,84	0,89	0,28	-0,96	0,42	-0,86	0,76	-0,73	1,02	0,59	0,57	0,46	0,07	1,1	-0,27	1,39	-0,64	0,5	1,53	1,66
F-45	677798	4063913	0,12	0,64	-0,25	-0,57	0,77	-0,35	0,88	0,04	0,47	0,26	0,18	1,16	0,14	-0,31	0,45	1,04	-0,55	0,7	0,4	0,06
F-44	676980	4061670	-0,37	-0,82	-1,04	0,67	0,98	0,06	0,14	-1,35	0,72	-0,89	-1,16	0,45	-0,73	0,44	1,27	0,74	-0,3	1,29	1,04	1,57
F-43	676003	4060805	-0,23	-0,45	-0,07	0,56	1,39	0,54	0,15	-1,48	1,85	-1,01	-1,22	1,4	0,61	1,12	1,22	0,61	-0,12	1,18	0,7	0,56
F-42	676705	4060313	-0,01	-1,41	-0,01	1,22	1,31	0,18	0,13	-1,59	0,16	-1,01	-1,37	0,17	0,25	0,3	1,33	0,64	-0,22	-0,17	0,72	1,78
F-41	677700	4061345	0,34	-1,43	-1,35	1,28	0,86	0,15	0,13	-1,34	1,19	-1,07	-1,18	0,44	0,69	0,53	1,31	1,48	-0,09	0,69	0,61	0,31
F-40	677976	4062819	0	0,83	-0,31	0,38	0,84	0,16	0,42	-0,37	0,2	-0,28	-0,38	0,39	0,55	1,52	0,19	0,66	-0,28	0,37	0,55	0,14
F-39	678685	4063745	0,33	0,29	-0,19	-0,25	0,95	-0,38	0,55	0,3	0,4	0,29	0,32	1,11	0,17	1,07	0,21	0,96	-0,56	0,17	0,95	0,45
F-38	679251	4064155	0,79	0,25	-0,68	0,09	0,05	-0,65	0,23	0,35	0,4	0,43	0,58	0,36	-0,06	-0,15	1,03	0,72	-0,68	-0,91	0,61	0,99
F-81	680053	4064611	2,15	-0,03	0,18	-0,56	-1,4	-1,52	-0,7	-0,56	0,91	2,13	2,12	-0,07	0,55	-0,36	-0,33	0,34	-0,74	-1,02	-0,13	-0,99
F-37	678793	4062439	0,26	0,87	-0,92	-0,2	1,03	0,05	0,69	-0,23	-0,56	-0,06	-0,06	1,08	-0,92	0,39	0,39	0,82	-0,19	0,97	0,85	0,72
F-36	679773	4063445	0,9	0,52	-0,68	0,14	0,61	-0,44	0,73	-0,04	0,25	0,31	0,22	0,92	0,67	1,09	0,49	1,08	-0,56	0,28	1,1	-0,19
F-35	679600	4062065	1,03	1,04	-0,8	0,11	1,02	-0,03	1,03	-0,25	-0,45	0,05	-0,22	0,55	-0,19	-0,29	0,16	0,71	-0,24	-0,06	0,89	0,22
F-34	678659	4060908	0,28	1,18	-0,56	0,5	1,26	0,87	0,6	-0,79	-0,84	-0,7	-0,75	0,8	-0,81	-0,33	-0,02	0,24	0,42	1,75	1,49	-0,17
F-33	677723	4059825	0,84	0,62	0,9	0,7	1,52	0,68	0,91	-1,01	-0,62	-0,63	-0,88	1,21	-0,73	-1,33	0,46	0,55	0,12	1,75	1,14	2,76
F-32	678667	4059442	-0,96	0,69	-1,22	0,15	1,27	0,94	0,23	-1,15	-1,31	-0,96	-1,16	-0,83	0,6	-0,33	0,33	0,18	0,28	0,14	-0,03	-0,19
F-31	679543	4060525	-1,19	0,75	-0,43	-0,06	1,47	0,4	0,69	-1,05	-1,46	-0,86	-0,96	0,32	-1,17	-1,42	0,16	0,78	0,58	1,78	0,68	-0,83
F-30	680315	4061729	-1,21	1,51	0,05	-1,66	1,19	-0,29	1,46	-0,65	-0,52	-0,18	-0,64	0,64	-0,75	0,3	-0,1	1,61	-0,63	0,01	0,97	1,1
F-80	681072	4063573	0,08	1,01	1,08	-0,34	2,53	-0,48	2,7	-0,95	0,01	-0,27	-0,78	1,41	-1,18	0,82	0,22	2,22	-0,88	1,55	2,52	0,99
F-29	680862	4062964	-0,67	0,29	0,42	-0,86	0,38	-0,63	0,52	-0,74	-1,05	-0,67	-0,76	0,1	-1,55	0,35	0,96	0,71	-0,83	0,65	0,5	-0,21
F-28	680903	4061463	-1,46	0,29	-0,92	-1,04	0,72	-0,44	1,08	-0,55	-0,6	-0,47	-0,8	0,44	-0,37	0,69	0,34	1,13	-0,62	0,61	0,87	0,18
F-27	681579	4062136	-1,28	1,43	-0,74	-1,28	0,08	-0,38	0,41	-0,55	-0,87	-0,6	-0,6	-0,43	-0,71	-1,35	-0,18	0,5	-0,85	-0,55	0,05	1,26
F-26	682323	4061719	-0,99	1,73	0,05	-1,08	0,46	-0,39	1,28	-0,24	-0,61	-0,45	-0,73	0,01	-1,47	1,39	-0,91	0,73	-0,88	0,69	0,78	-0,13
F-25	681554	4061164	-0,4	0,87	-0,68	-1	2	-0,68	2,29	-0,76	-1,13	0,07	-0,89	1,43	-1,28	1,03	0,07	2,44	-0,76	1,29	1,13	-0,01
F-24	680482	4060097	-1,14	0,34	-1,22	-0,23	0,8	0,46	0,29	-0,82	-1,28	-1,02	-0,78	-0,27	-0,82	-0,62	-0,02	-0,11	0,57	0,31	0,12	-1,62
F-23	679671	4059085	-1,7	-1,06	-0,31	-0,12	0,67	0,17	-0,02	-1,47	0,18	-1,17	-1,29	-0,53	1,08	0,48	0,48	0,1	-0,17	1,78	0,14	-0,52
F-22	680736	4058572	0,24	-1,02	0,42	0,77	0,71	-0,19	0,03	-1,37	0,54	-0,87	-1	0,51	0,4	0,53	1,34	1,01	-0,4	1,15	0,19	0,83
F-21	682368	4060784	-0,99	0,87	-1,1	-0,62	1,54	-0,41	1,61	-0,35	-0,39	0,15	-0,53	0,26	0,43	-0,22	-0,24	0,75	-0,43	0,28	0,78	-1,31
F-19	683306	4060356	-0,32	0,42	0,17	-0,64	0,61	-0,43	1,12	-0,5	-0,86	-0,15	-0,66	0,45	-0,56	-0,42	0,29	1,06	-0,75	1,18	0,95	0,18
F-18	681776	4058139	-0,18	-0,28	-0,19	-0,01	0,79	-0,58	0,75	-0,55	1,83	0,1	0,09	0,77	-1,68	1,57	0,72	0,44	-0,52	0,72	1,35	0,91
F-17	682873	4057768	-0,83	0,13	-0,68	-0,57	0,8	-0,04	0,35	-1,09	-0,41	-0,54	-0,46	-0,27	-2,5	0,39	0,31	0,46	-0,41	0,15	0,5	0,68
F-16	684254	4059913	0,12	0,95	0,66	-0,56	0,45	-0,33	0,7	-0,53	-0,85	-0,13	-0,55	0,53	-0,43	-0,17	0,45	0,62	-0,6	0,22	0,67	0,91
F-15	684122	4060834	0,5	1,41	-0,19	0	0,29	-0,18	1,01	0,12	-0,04	-0,07	-0,5	0,14	0,42	0,53	-0,17	0,23	-0,73	2	1,5	0,41
F-14	685241	4060507	0,78	0,83	0,29	0,02	0,15	-0,11	0,65	-0,06	-0,67	0,07	-0,39	-0,24	0	1,98	0,4	0,27	-0,61	0,19	0,87	1,57
F-13	685292	4059431	0,66	0,73	-0,56	-0,26	0,17	-0,19	0,61	-0,23	-0,08	0,11	-0,31	0,96	1,02	1,23	0,29	0,27	-0,48	0,56	0,52	0,51
F-12	684102	4058485	0,92	0,5	2,36	0,28	0,14	-0,59	0,84	0,61	1,66	1,05	0,69	0,07	0,19	0,71	-0,37	0,09	-0,48	-1,12	-0,15	-0,01
F-11	683750	4057461	-0,26	-0,03	-1,16	0,55	0,28	-0,08	0,33	-0,54	0,02	-0,45	-0,49	0,07	0,7	1,71	0,35	-0,38	0,09	-0,06	-0,34	0,18
F-10	684523	4057009	-0,43	-0,34	0,29	0,14	0,47	0,15	0,28	-0,9	0,09	-0,53	-0,42	0,4	-0,68	0,14	1,1	0,35	-0,18	1,36	0,32	0,95
F-9	685095	4058061	0,39	-0,06	-0,37	0,84	0,13	0,21	-0,24	0,31	-0,28	-0,08	-0,05	-0,09	0,37	0,89	0,12	-0,3	0,22	0,15	0,24	0,29
F-8	686399	4058994	1,18	0,83	-0,56	0	0,26	-0,13	0,36	-0,12	0,07	0,32	-0,1	0,55	1,94	0,35	0,25	0,29	-0,42	0,37	0,15	-0,36
F-7	686293	4060059	0,77	0,75	0,29	0,31	0,16	-0,14	0,49	-0,08	-0,01	0,27	-0,23	-0,09	1,18	0,26	1,05	-0,19	-0,5	0,37	0,28	0,1
F-6	686644	4058081	1,96	0,17	0,54	1,91	0,26	-0,34	0,3	-0,31	1,37	0,69	0,15	0,45	0,63	0,12	2,13	0,23	-0,33	-0,09	0,25	1,37
F-5	687413	4059172	0,9	0,64	0,29	0,26	-0,52	0,2	-0,41	0,98	-0,26	0,33	-0,28	-0,64	1,28	0,14	-0,68	-1,18	0,09	0,79	0,87	0,1
F-4	688268	4057693	2,73	-0,32	0,29	0,19	-0,39	-1,08	-0,07	0,14	0,62	1,46	1,2	-0,42	-0,49	0,24	1,02	0,37	-0,72	-0,59	0,92	-0,05
F-3	688386	4056817	1,67	-1,02	-0,07	0,72	-0,3	-0,53	-0,24	-0,49	0,26	0,92	0,09	0,04	0,55	1,84	0,42	-0,01	-0,3	0,33	1,89	-0,59
F-2	688363	4056177	2,14	-2,01	0,78	1,85	-0,64	-1,12	-0,52	-0,71	-0,54	0,43	0,3	0,58	-1,26	1,03	2,34	0,24	-0,67	-0,31	0,65	1,26
F-1	687939	4055601	1,97	-1,84	2,24	2	-0,55	-1,06	-0,57	-0,76	0,27	0,67	0,4	1,27	-0,78	0,76	2,24	0,37	-0,58	0,19	0,89	1,93