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Characterization of a High Altitude Karst Aquifer in Eastern Turkey

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TÜBİTAK-ÇAYDAG
Project No: 106Y040

TÜBİTAK

N°abstract 2185

September 28, 2016
le Corum, Montpellier

25-29th September 2016
Montpellier, France
CORUM CONFERENCE CENTER
43rd IAH congress

Outline

- **Turkish Karst**
- **Study Area**
- **Scope**
- **Geology**
- **Sampling Points & Analysis**
- **Results**
  - Discharge
  - Hydrogeochemistry
  - Isotopic Studies
- **Conclusions**

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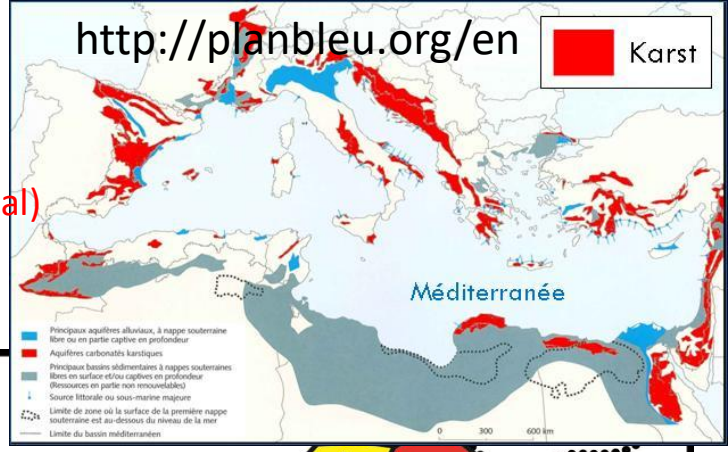
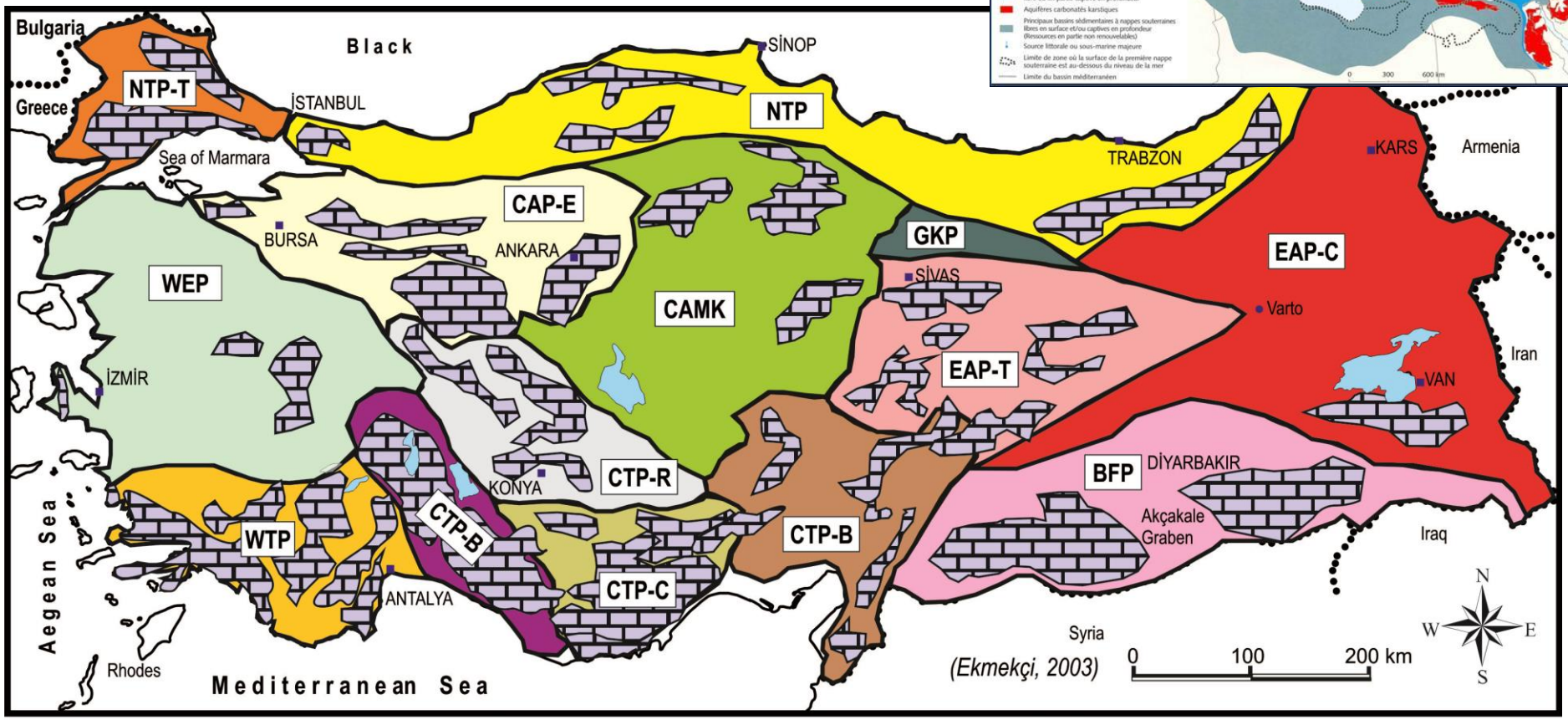
Turkish Karst

1/3 (~260.000 km^2) of Turkey's surface area (780.532 km^2)…

the large diversity of karst types (geographical, geological, hydrogeological)

13 provinces by Ekmekçi (2003) based on factors…





NTP: Northern Province

NTP-T: Northern Province-Thrace section

WEP: West Extensional Province

WTP: Western Taurids Province

CTP-B: Central Taurids Province-Border section

CTP-C: Central Taurids Province-Central section

CTP-R: Central Anatolian Province-Rejuvenated Karst

CAP-E: Central Anatolian Province-Evolutionary (relict) karst

CAMK: Central Anatolian Province-Marble karst

GKP: Eastern Anatolia Province-Gypsum karst

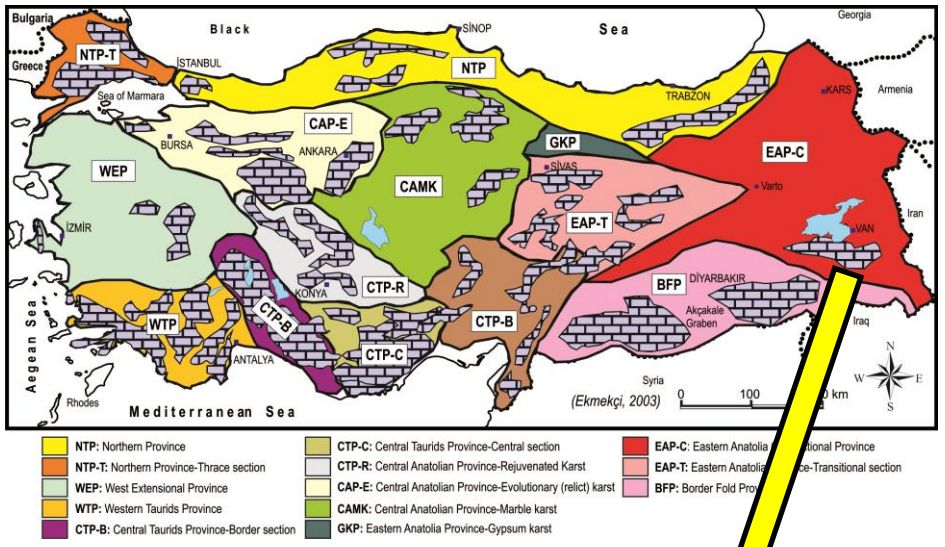
EAP-C: Eastern Anatolia Contractional Province

EAP-T: Eastern Anatolia Province-Transitional section

BFP: Border Fold Province

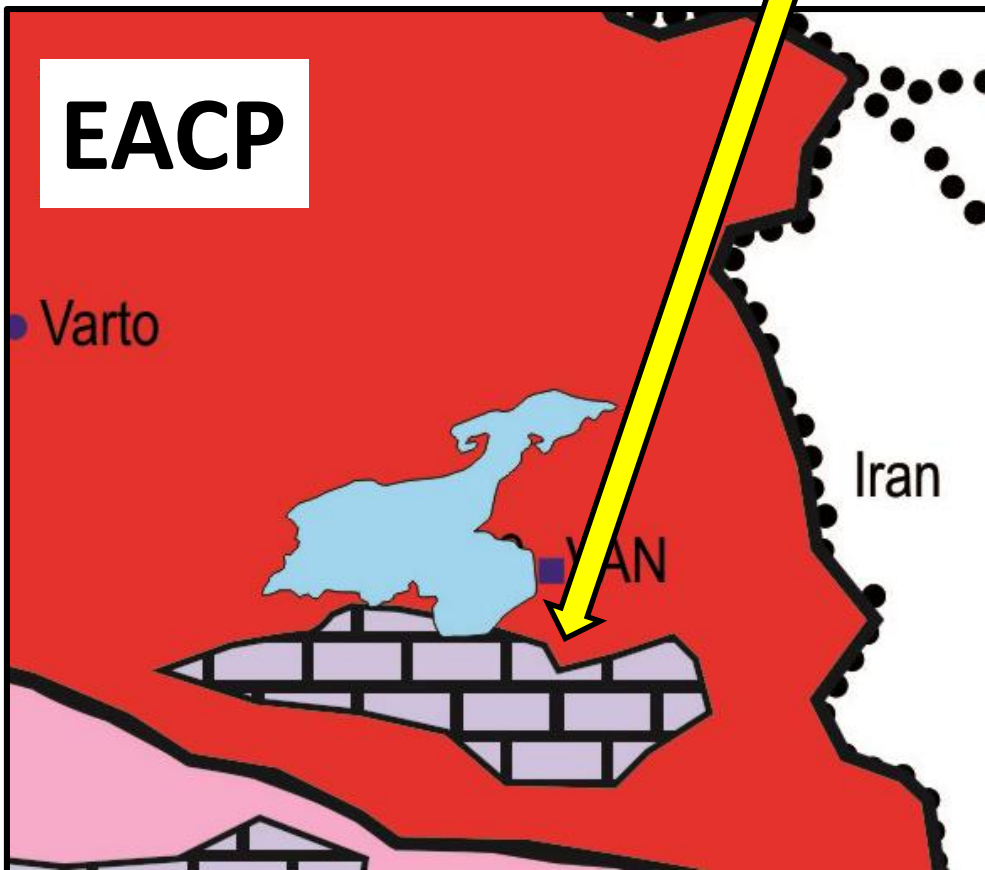
Karst in Eastern Turkey (Anatolia)

the major part of karst areas in Turkey are represented by evolutionary (paleo) karst



East Anatolian Contractional Province (EACP)

- covered to a large extent by volcanic rocks and/or volcano-sedimentary deposits
- marble karst
- lack of surfical karst features such as extensive dolines, uvalas or poljes
- well developed underground fatures



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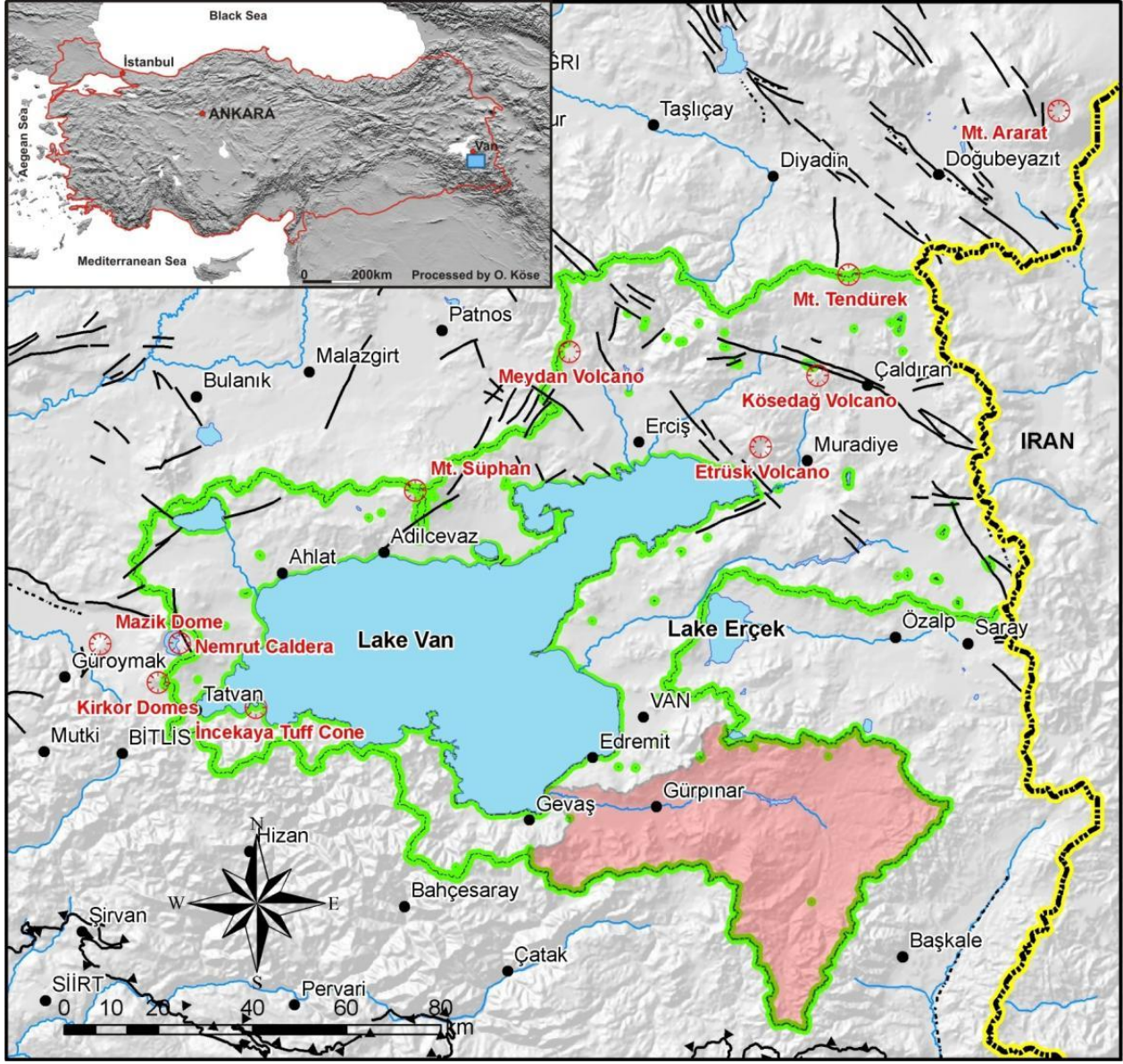
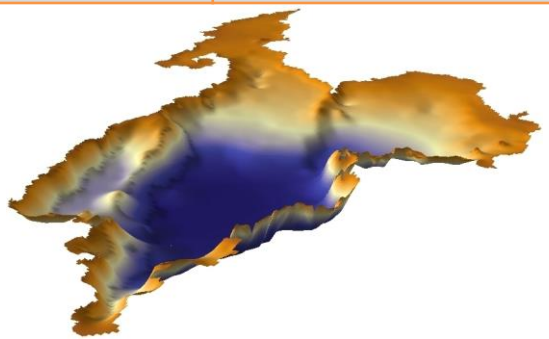
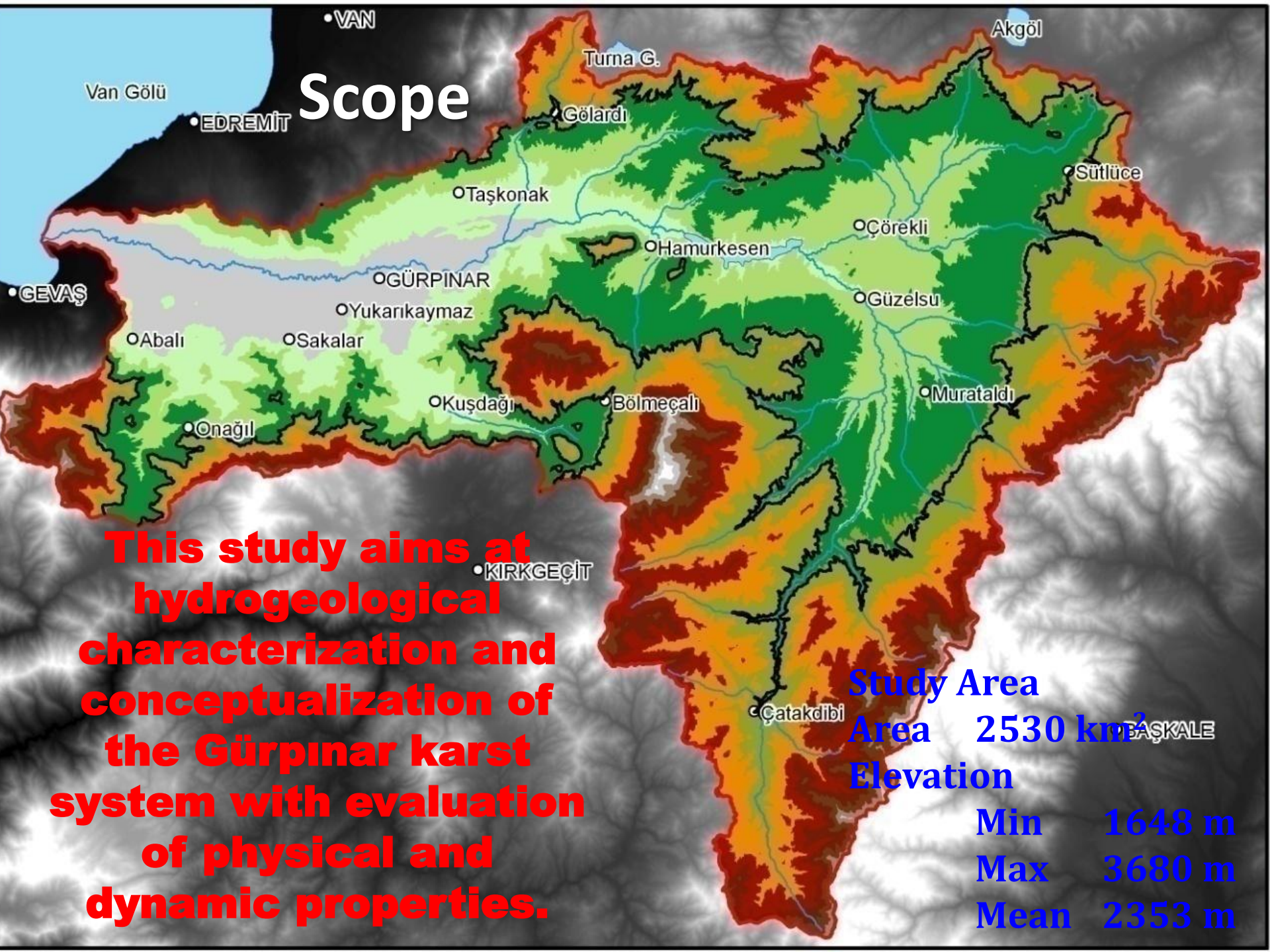
Basin	Drainage Area (km^2)	Total:15495.98 Land: 11854.90 Lakes: 3641.08
Lake Van	Surface Area (km^2)	Ave: 3580.9 Min: 3558.3 Max: 3623.6
	Water Level (m asl.)	Ave: 1648.33 Min: 1646.97 Max: 1650.55
	Depth (m)	Ave: 162.42 Max: 452.91
	Volume (km^3)	Ave: 568.1 Min: 563.3 Max: 575.0



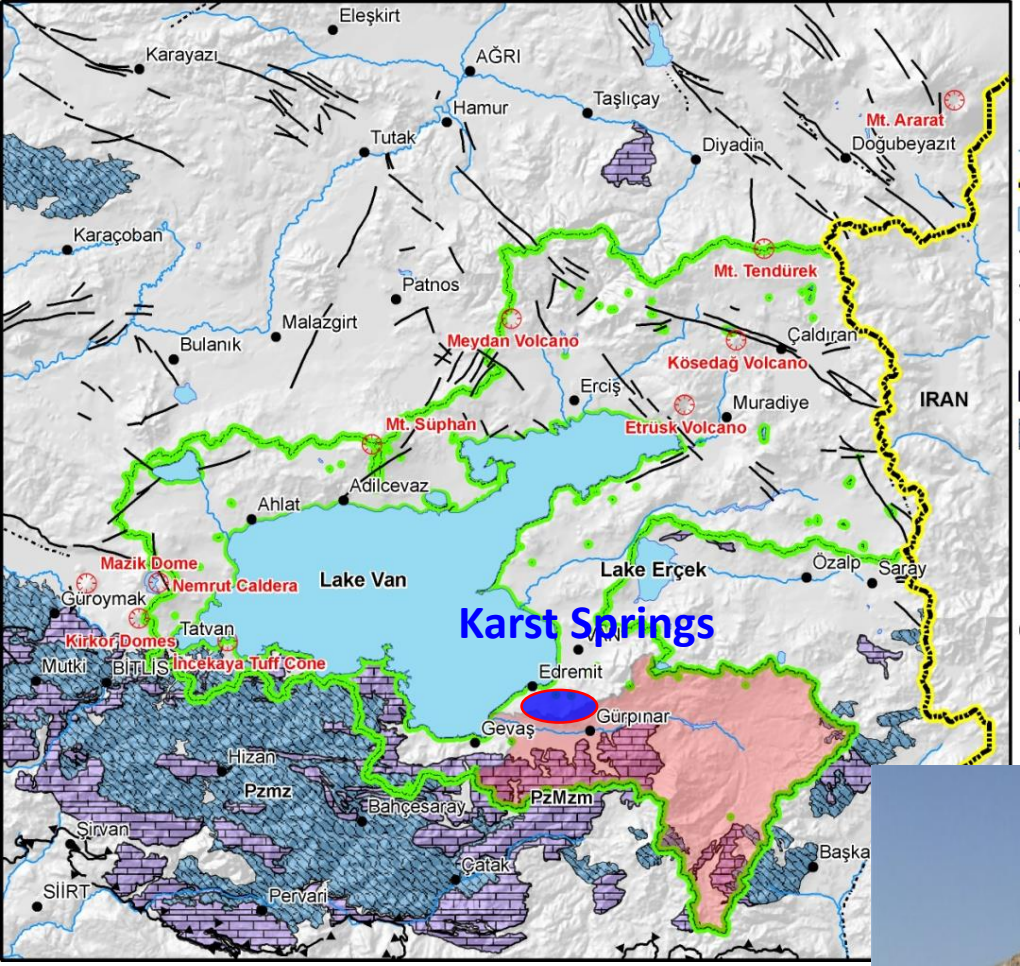


Study Area


Scope
VAN
Akgöl
Turna G.
Van Gölü
EDREMİT
Gölardı
Sütlüce
Taşkonak
Çörekli
Hamurkesen
GÜRPINAR
GEVAŞ
Güzelsu
Yukarıkaymaz
Abalı
Sakalar
Kuşdağı
Bölmeçalı
Muratalдı
Onağıl
KIRKGEÇİT
Çatakdibi
BAŞKALE
This study aims at hydrogeological characterization and conceptualization of the Gürpınar karst system with evaluation of physical and dynamic properties.
Study Area
Area 2530 km2
Elevation
Min 1648 m
Max 3680 m
Mean 2353 m

Geology

Drinking Water



Legend

- City
- Sampling Locations
- Recent Volcanoes
- River
- Boundary
- Lake and dam
- Fault
- Probable fault
- Thrust fault

Description of Geological Units

- PzMzm — Paleozoic - Mesozoic, Bitlis Massif (Marble and recrystallized limestone)
- PzMz — Paleozoic - Mesozoic, Bitlis Massif (gneiss, schist, quartzite, etc.)

N, W, E, S

0 10 20 40 60 80 km

Modified from 1/500.000 scale maps of MTA.

N°abstract 2185

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Sampling Points & Analysis

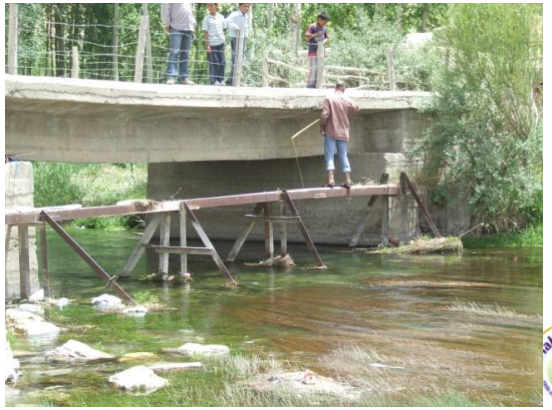
11 Karst Spring
34 Non-karst Spring
14 Surface Water

Field measurements (T, pH, EC, TDS, etc.) YSI 556 MP

Major ions Hacettepe University Ankara, TURKEY

^{3}H

Stable isotopes (^{18}O ve D) Perdue University Indiana, USA

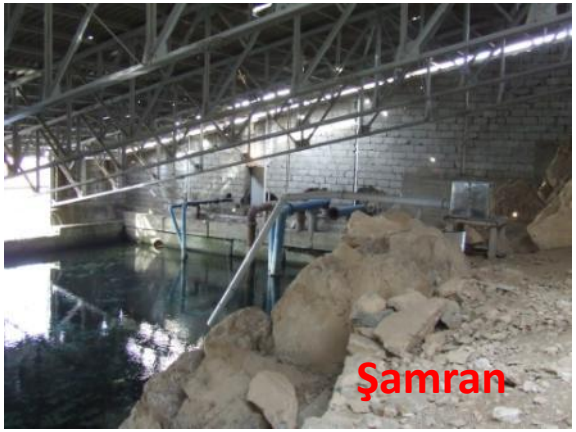


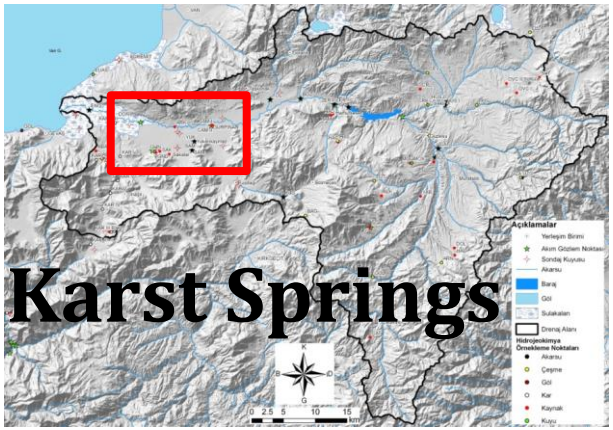
February 07, 2007


Şamran


Şamran


Akpınar


Şamran


Karst Springs
Açıklamalar

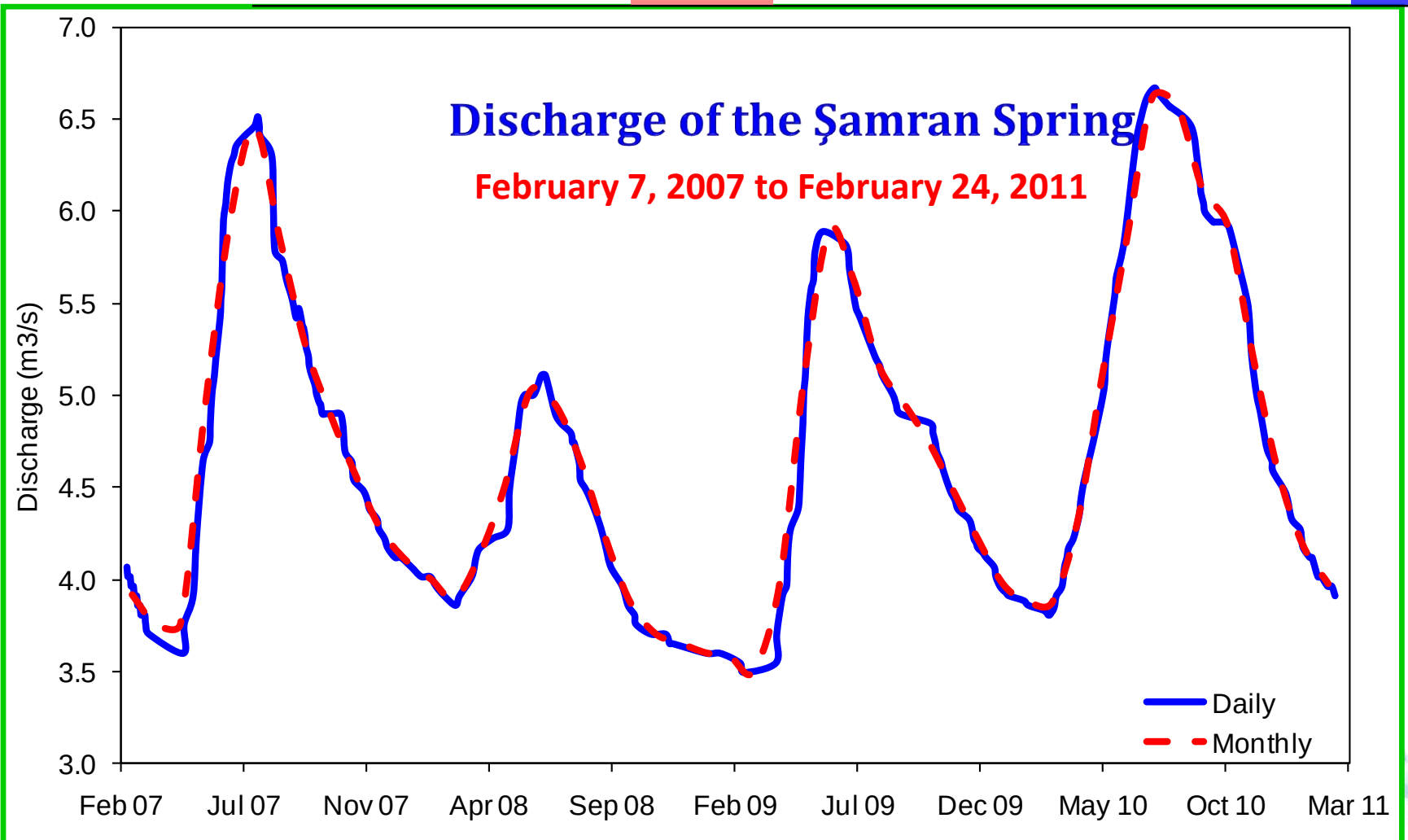

Dönemeç


Gündoğan Springs


Sakalar

Discharge

Parametres	Şamran (SAM)	Akpınar (CAM)	Gündoğan (GND)	Gündoğan (GUN)	Sakalar (SAK)	Sum
n	265	6	4	4	4	-
Average (m^3/s)	5.225	0.195	0.164	0.180	0.167	**5.445**
Min (m^3/s)	3.397	0.147	0.125	0.152	0.138	**4.059**
Max (m^3/s)	7.315	0.233	0.188	0.226	0.223	**7.549**



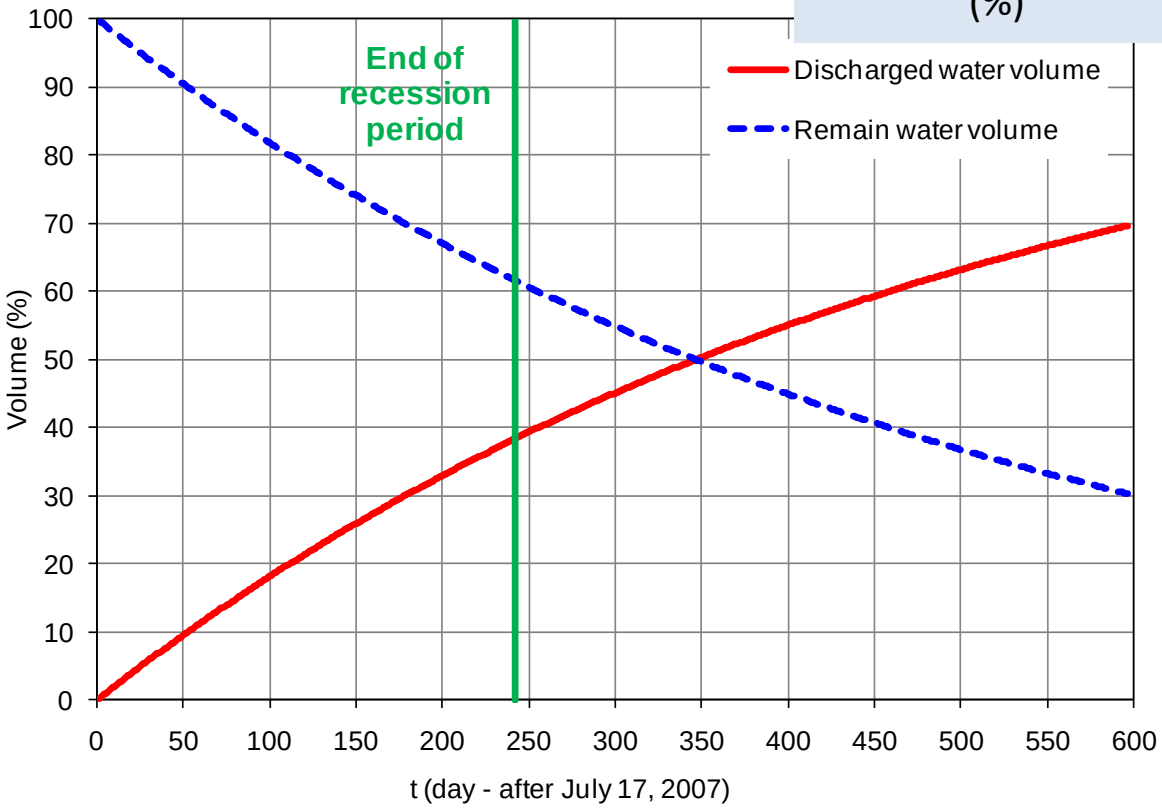
Aquifer Storage

Recession Period

July 17, 2007 to March 15, 2008

July 3, 2008 to March 3, 2009

	2007	2008
α (day^{-1})	0.002	0.0015
t (day)	242	243
V_t ($*10^6$ m^3)	242.61	289.38
V_d ($*10^6$ m^3)	98.1	86.43
(%)	40.42	29.9
V_r ($*10^6$ m^3)	144.5	202.95
(%)	59.58	70.10

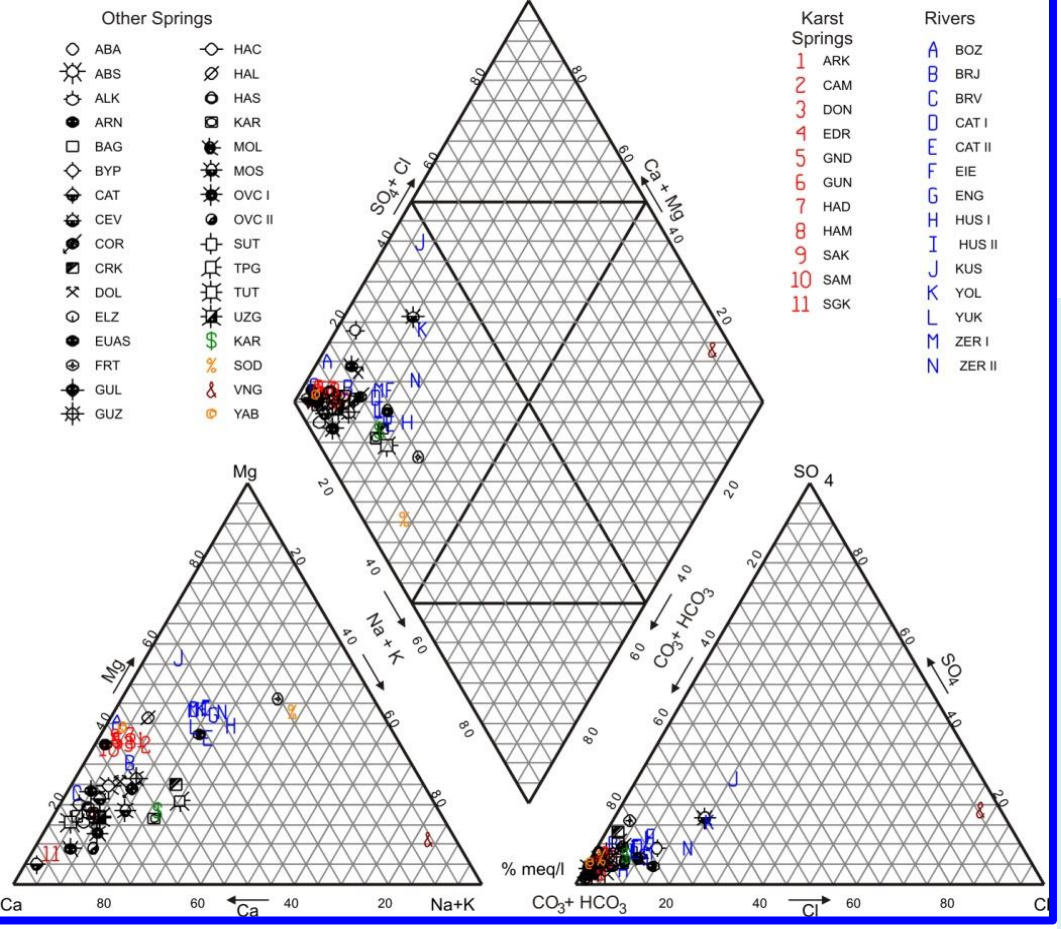


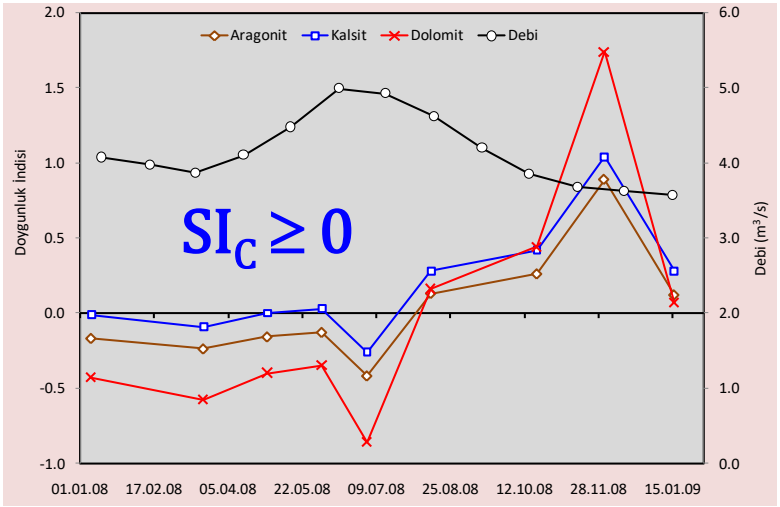
$$Q_t = Q_o * e^{-\alpha * t}$$

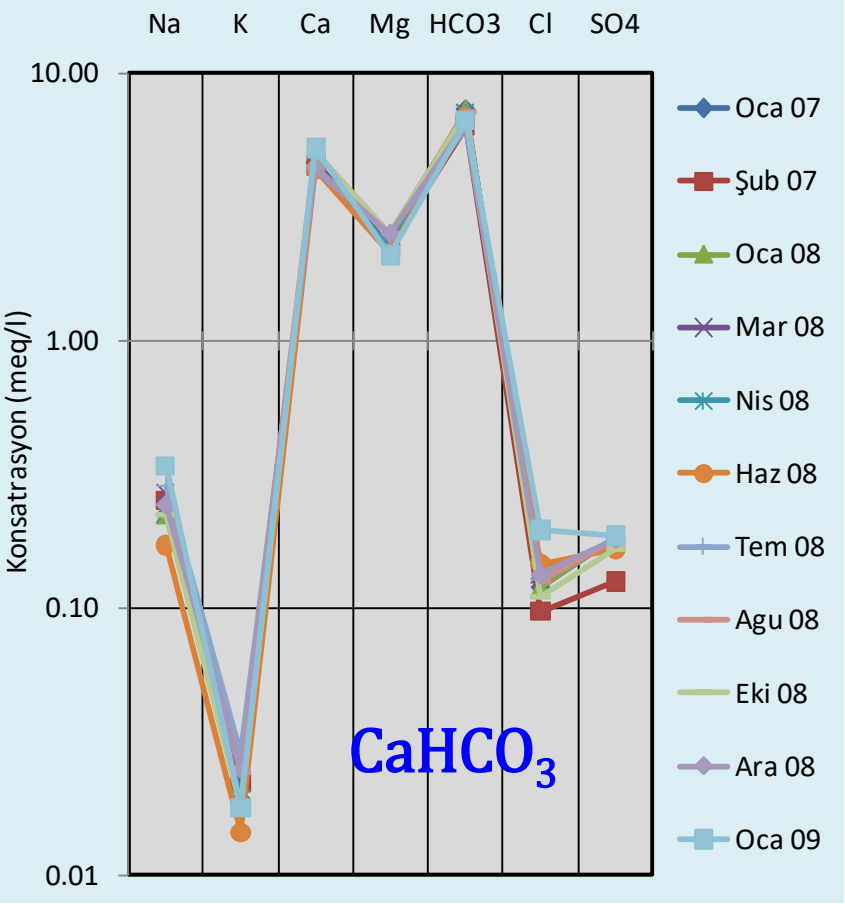
K↓ T↓ S↑

Fractured System

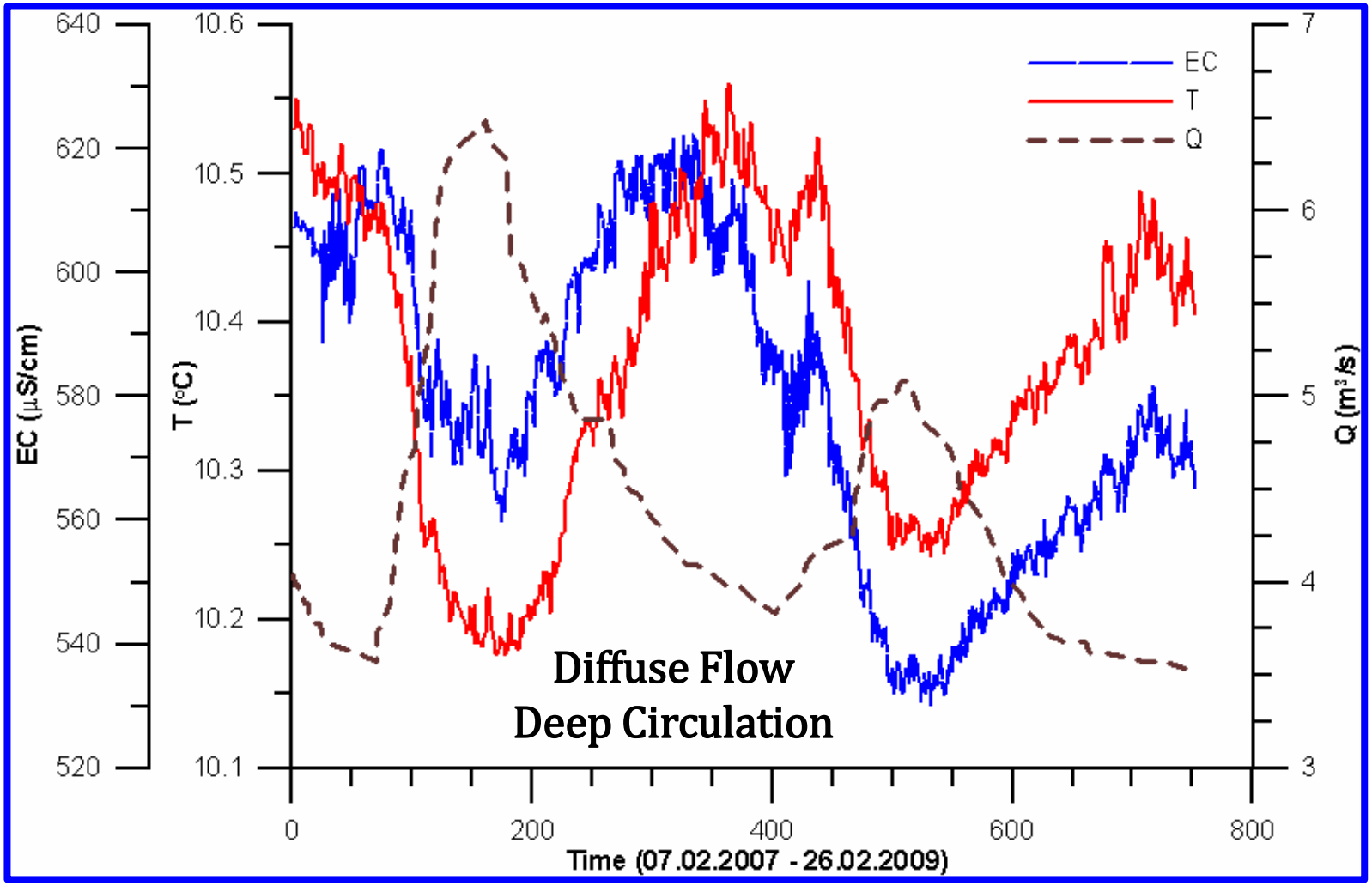
Hidrogeochemistry







Hidrogeochemistry (Field Measurements)

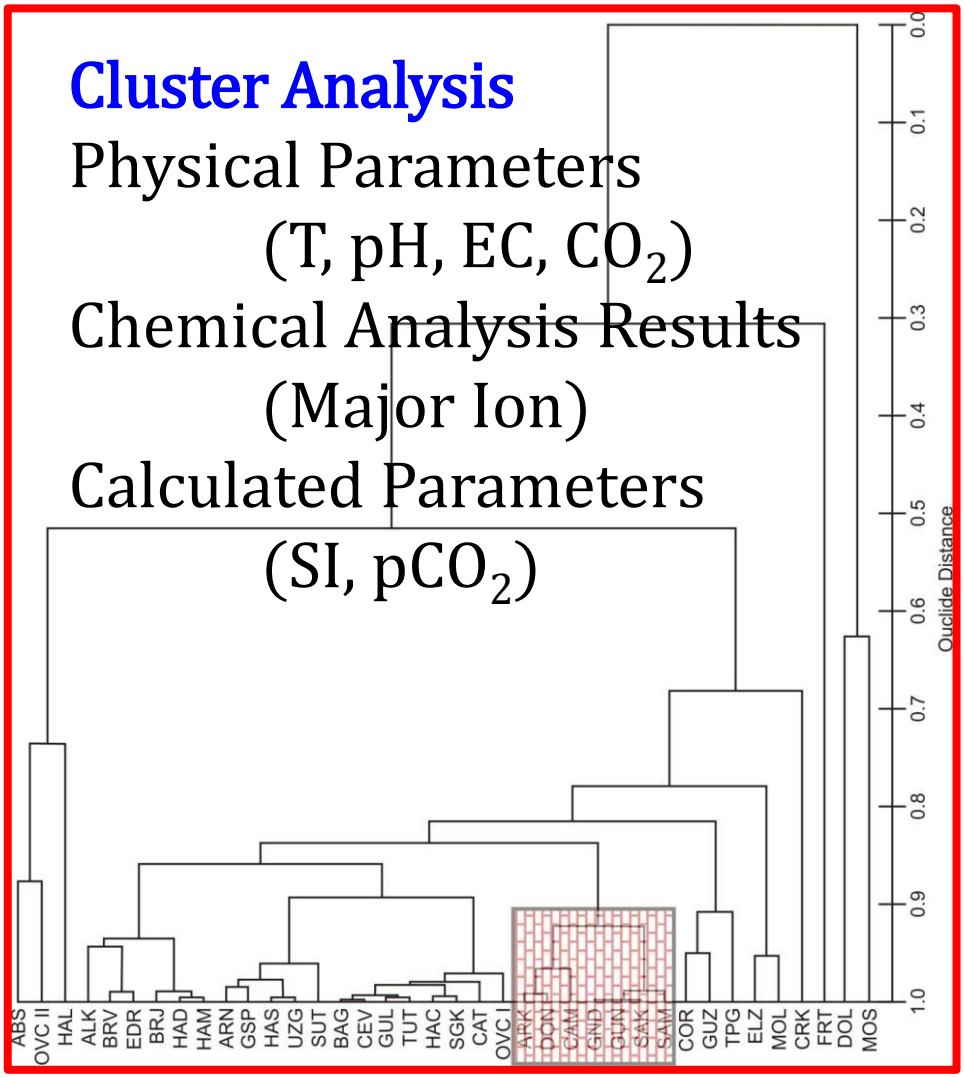


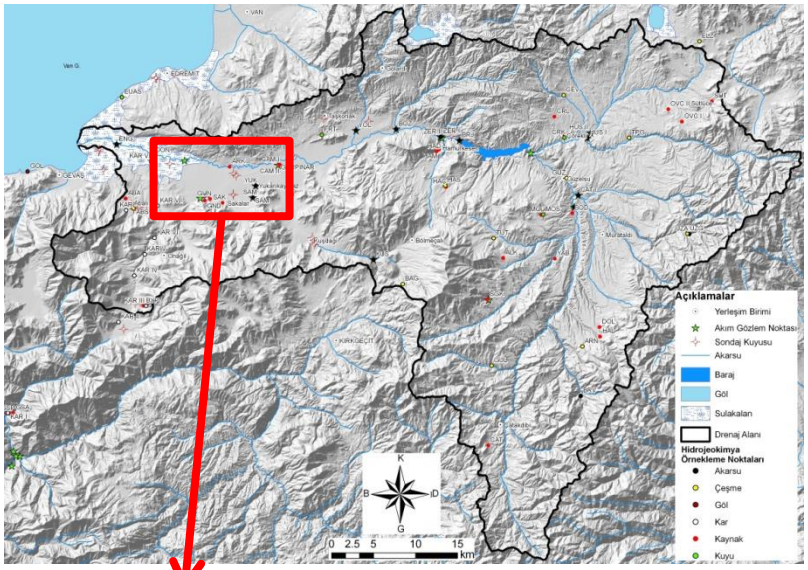
n 18577	pH	T (°C)	EC_A (µS/cm)	EC_{25} (µS/cm)
Min	6.27	10.17	464.00	647.37
Max	7.34	10.61	685.00	944.63
Ave	6.76	10.37	593.60	823.74
SD	0.14	0.11	22.25	27.6
CV	**2.02**	**1.06**	**3.75**	**3.3**

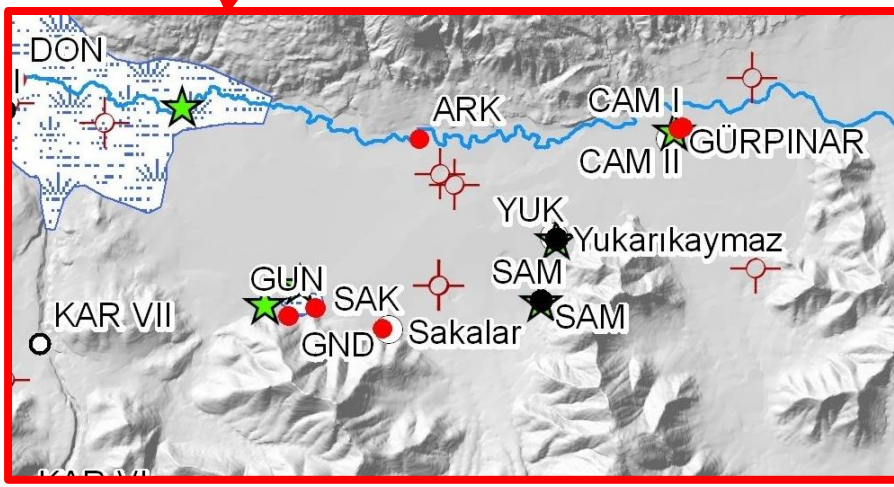
Hidrogeochemistry

Cluster Analysis

Physical Parameters
(T, pH, EC, CO_2)
Chemical Analysis Results
(Major Ion)
Calculated Parameters
(SI, pCO_2)



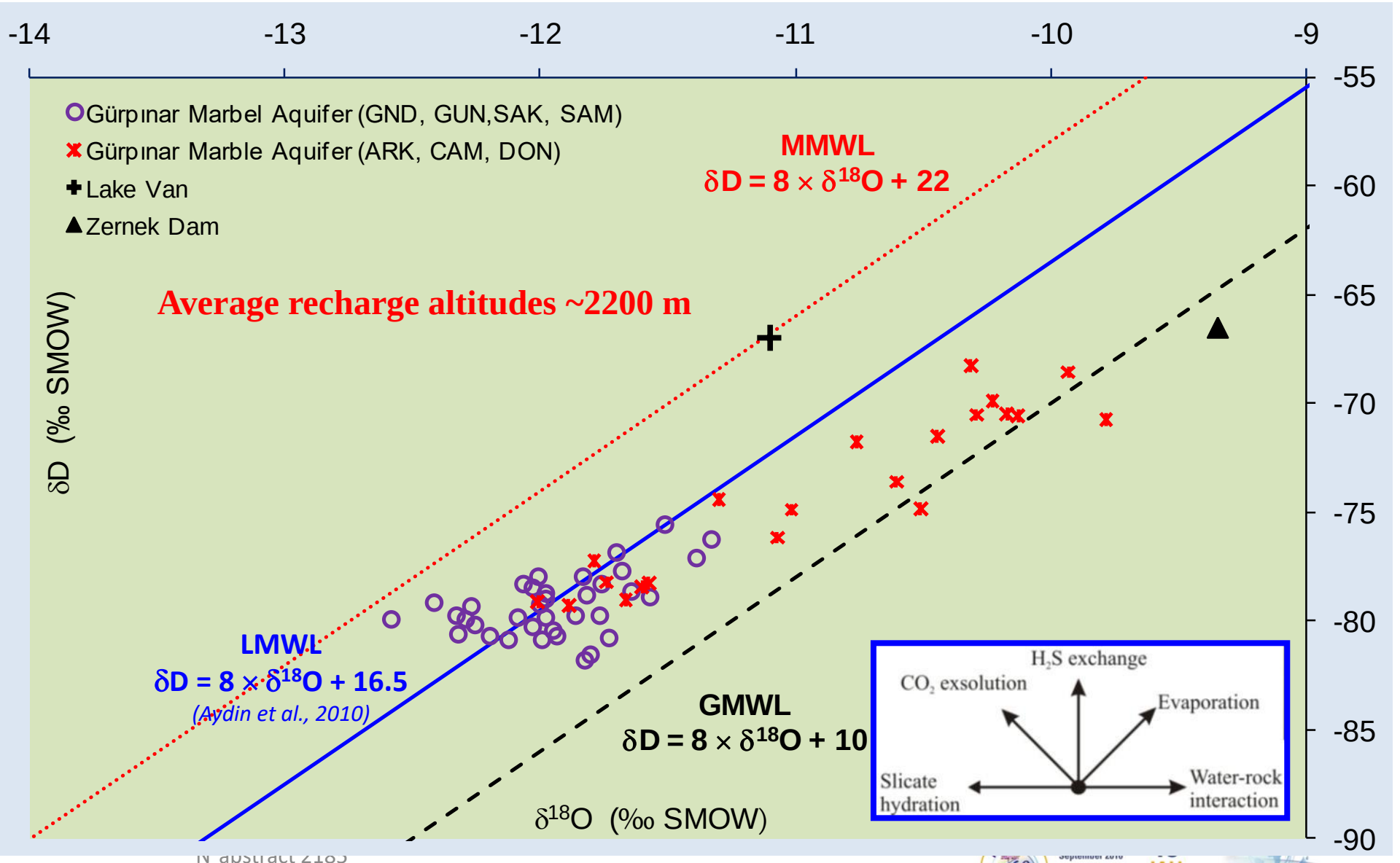




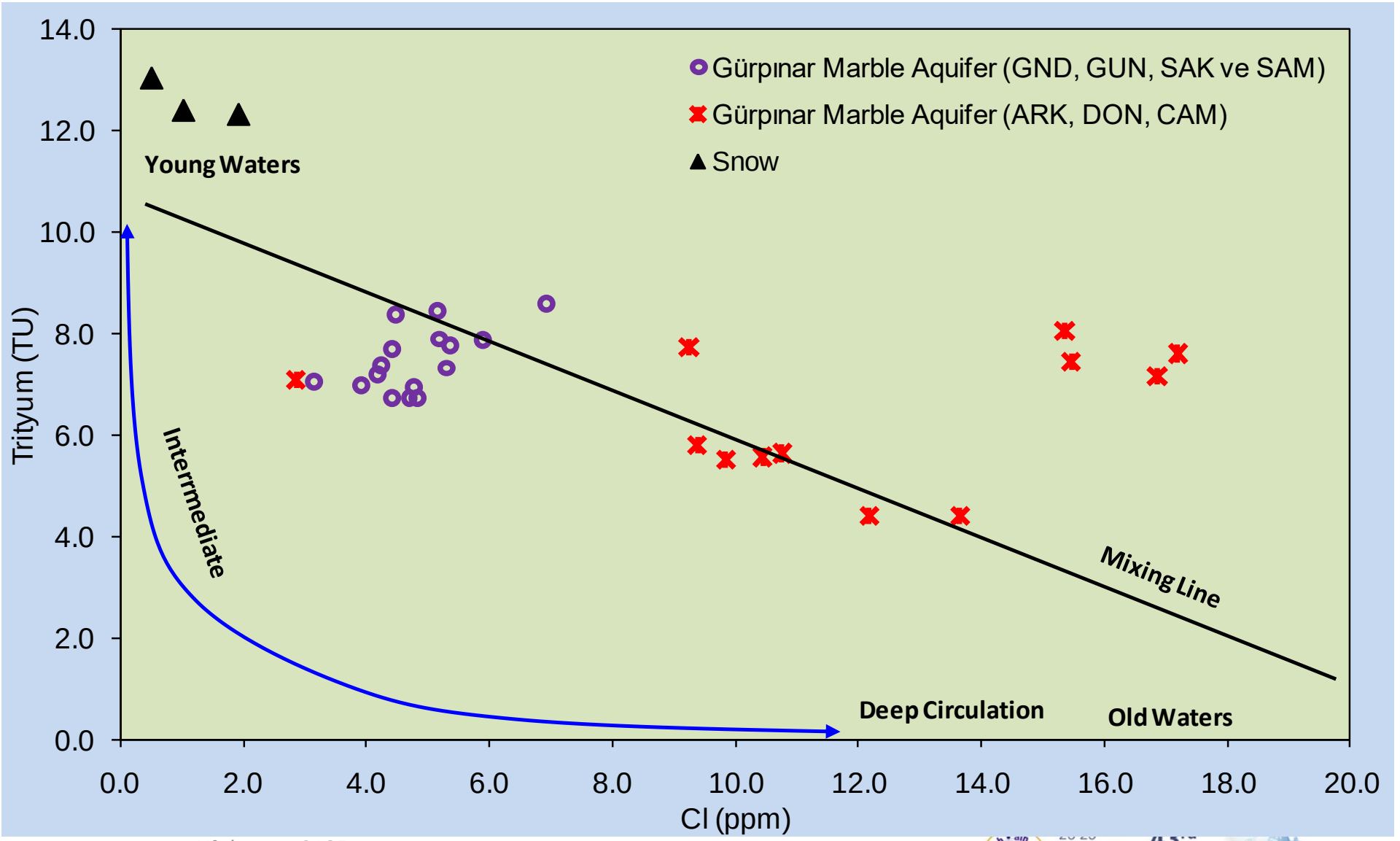
Two Different Flow System

Lower Plain Springs (ARK, CAM, DON)
Upper Plain Spring (GND, GUN, SAK, SAM)

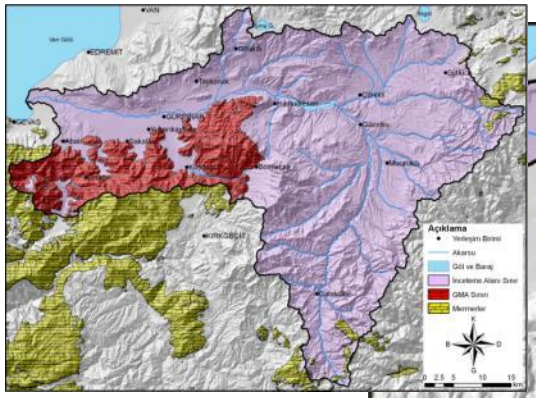
Isotopic Studies – Spring Waters

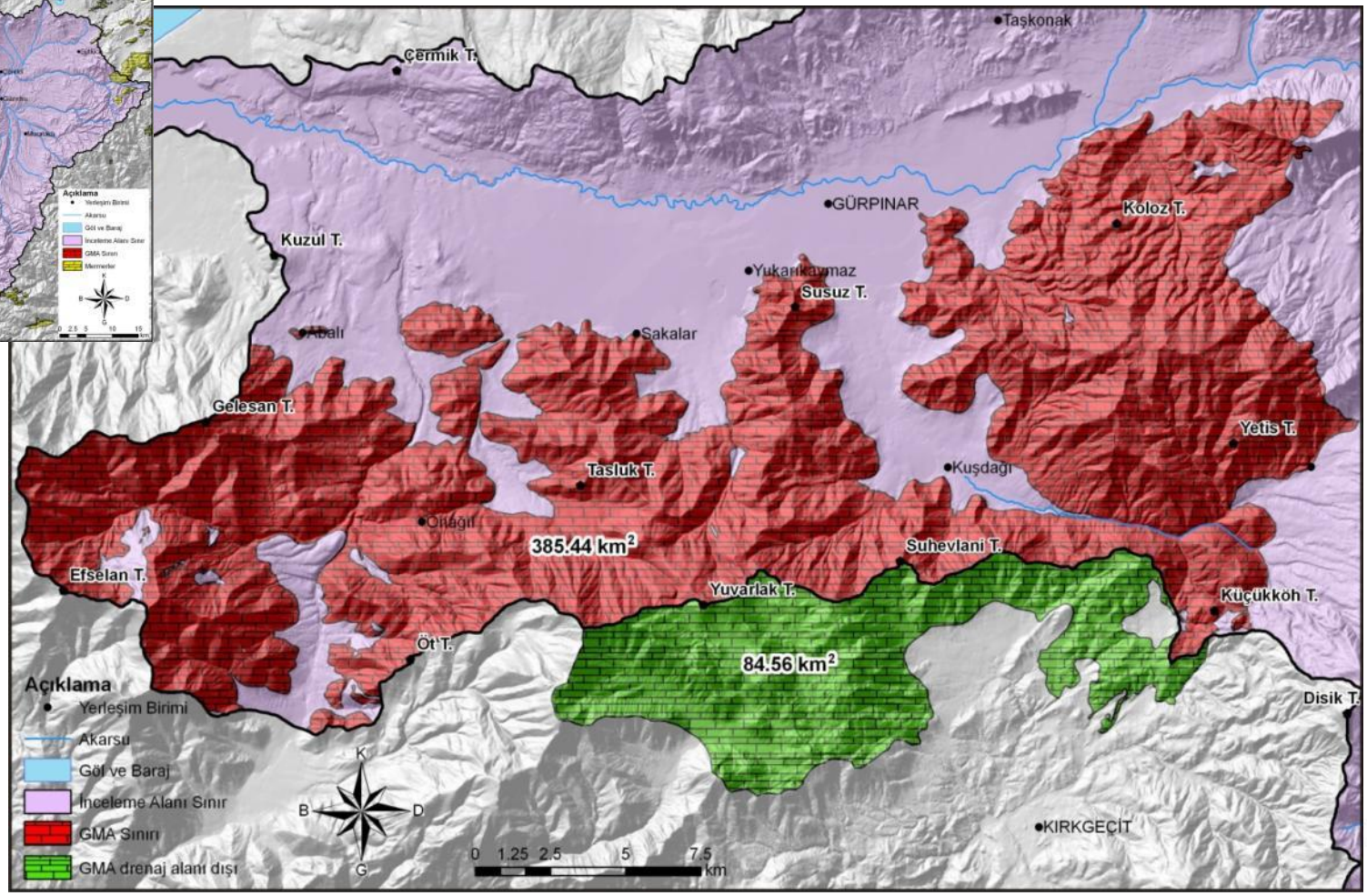


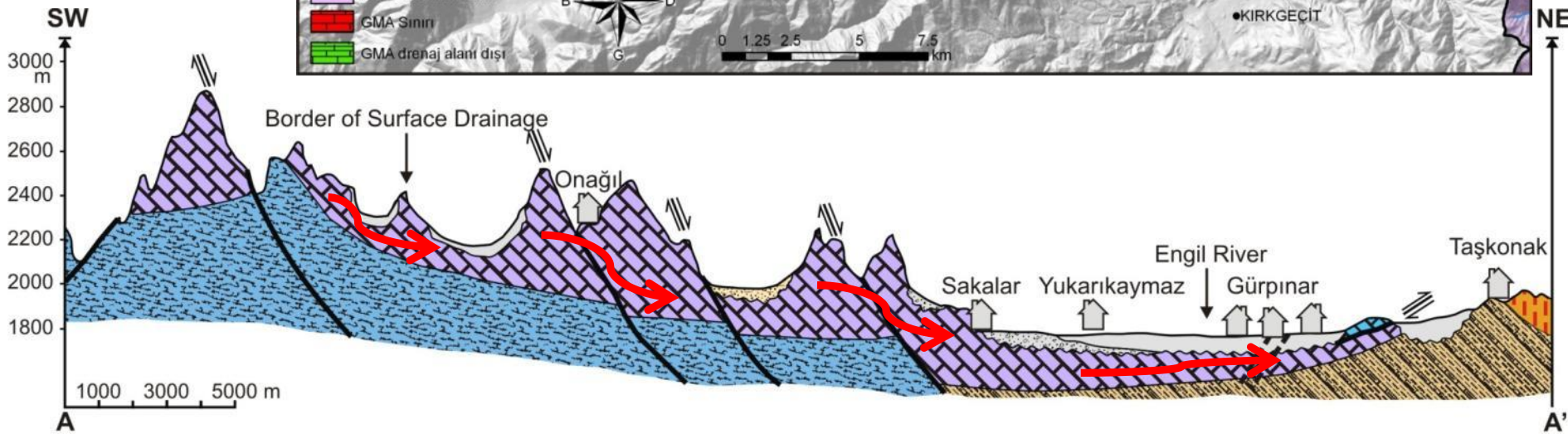
Isotopic Studies – Spring Waters



Conclusions

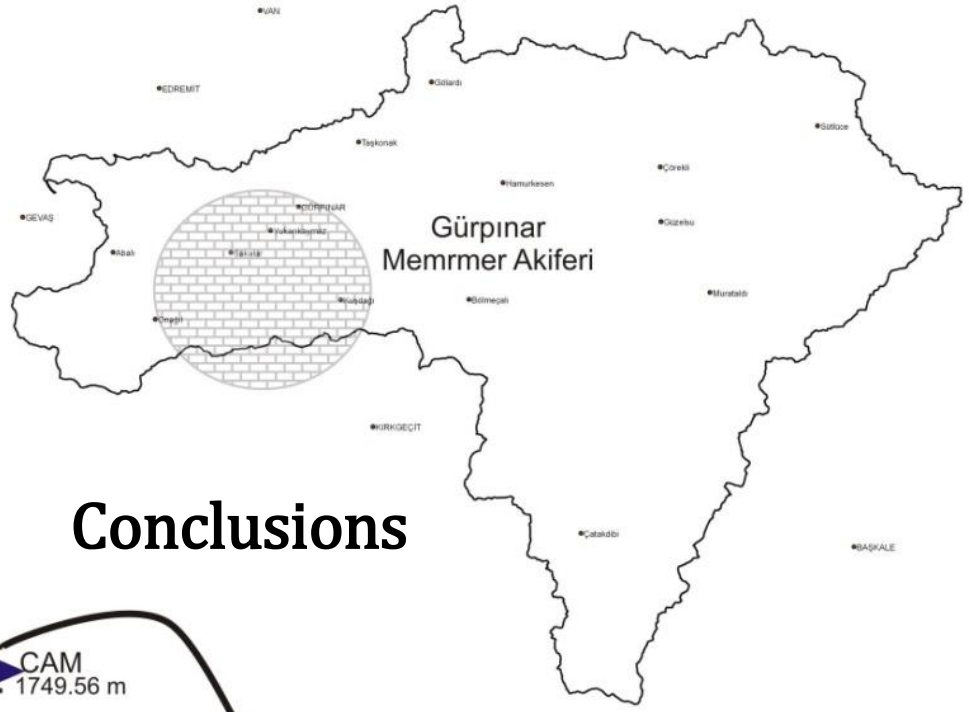






Allogenic Diffuse Recharge

Autogenic Diffuse Recharge



1

2

SAM
1760 m

SAK
1755.84 m

GUN
1752.32 m

GND
1750 m

CAM
1749.56 m

ARK
1720 m

DON
1677.91 m

Diffuse Flow

Karst Aquifer

Engil River

Conclusions

High Storage Capacity

Good Water Quality

Safe Water Resource

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Akdamar Church, Lake Van & Mt. Artos (Karst Aquifer)

Thanks for your attention…

This study was supported by The Scientific and Technological Research Council of Turkey (TÜBİTAK) with Project No: 106Y040.

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