Council for Development and Reconstruction (CDR)
Ministry of Energy and Water (MoEW)
Water Establishment Beirut and Mount Lebanon (WEBML)

Federal Institute for Geosciences
and Natural Resources (BGR),
Hannover, Germany

IAH Conference 2012 – Niagara Falls

German-Lebanese Technical Cooperation Project

Protection of Jeita Spring

Delineation of the Groundwater Contribution Zone of Jeita Spring, Lebanon, using Tracer Tests in a Karst Aquifer System

M2-D/Karst Artificial Tracers and Isotopes II
September 17, 2012

Dr. Armin Margane, BGR & Dr. Joanna Doummar, Univ. Goettingen

Outline

- Background of the Project / Aim / Tasks
- Description of Project Area
- Project Activities related to Project Component 2
  (delineation and implementation of GW protection zones)

Project Activities

Goal: *Major Risks for the Drinking Water Supply in the Greater Beirut Area are reduced by implementing measures to protect the groundwater contribution zone of the Jeita Spring from pollution*.

1. **Integration of water resources protection aspects into the investment planning and implementation process in the wastewater sector (geoscientific advice in wastewater sector)**
2. **Integration of water resources protection aspects into landuse planning (delineation of GW protection zones)**
3. **Collection and use of monitoring data concerning quality and quantity of water resources**
4. **Support of the partner institutions concerning the implementation of urgent protective measures**

Data Availability

- Insufficient and inadequate meteorological stations/data (not heated > no snow data)
- No groundwater monitoring > no water levels > no GW model
- Spring discharge monitoring stations not adequately designed, maintained and monitored
- Surface water gauging stations not adequately designed and maintained

► lack of funds and staff

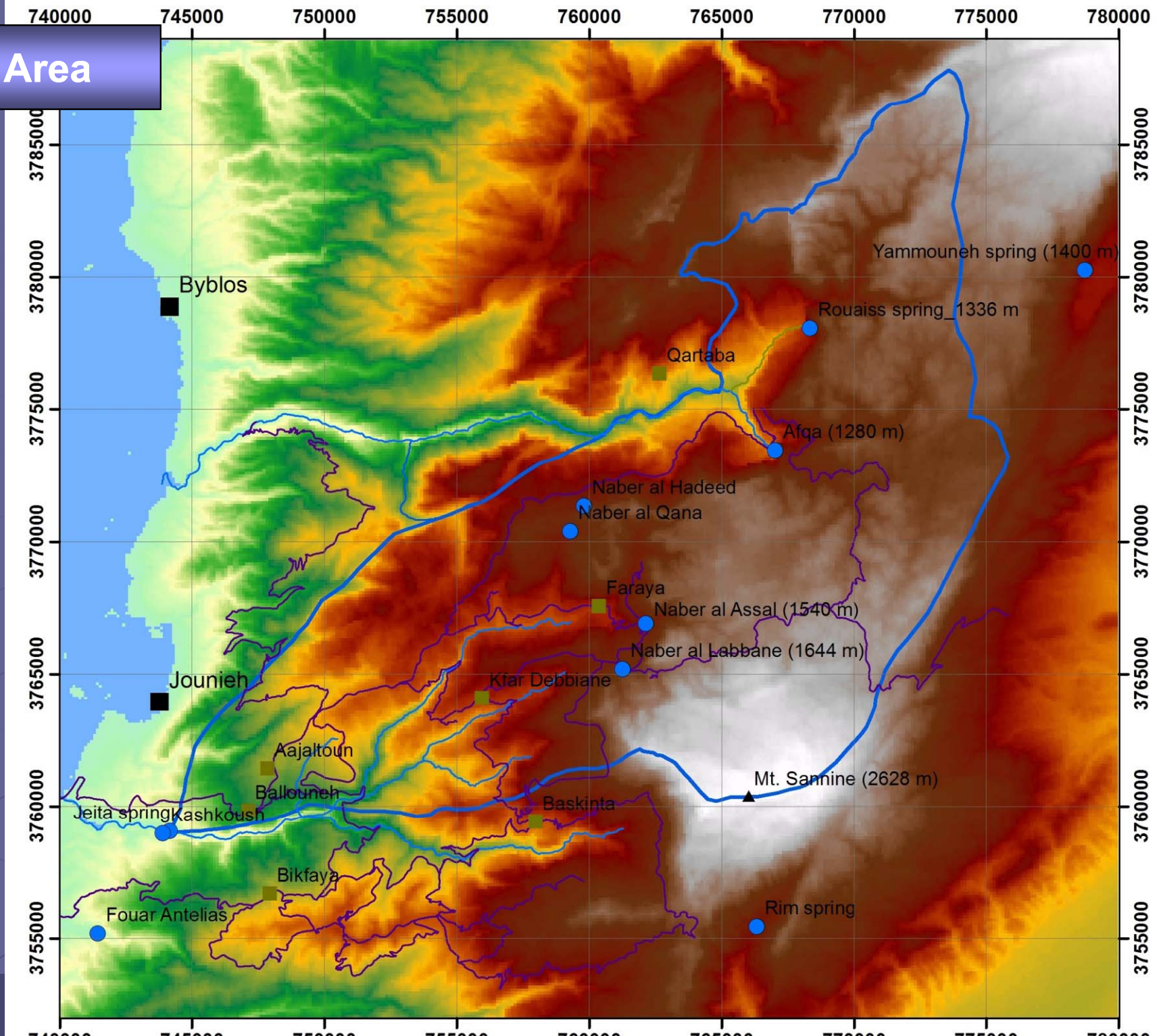
Water resources assessment needs monitoring system for all water balance components

- rainfall / snow
- spring discharge
- runoff (surface water)
- groundwater abstraction
- irrigation water use (return flow)
- domestic water use / losses (return flow)

► no data > no correct water resources assessment
► wrong water resources assessment leads to wrong planning !
► failed investments in the water sector

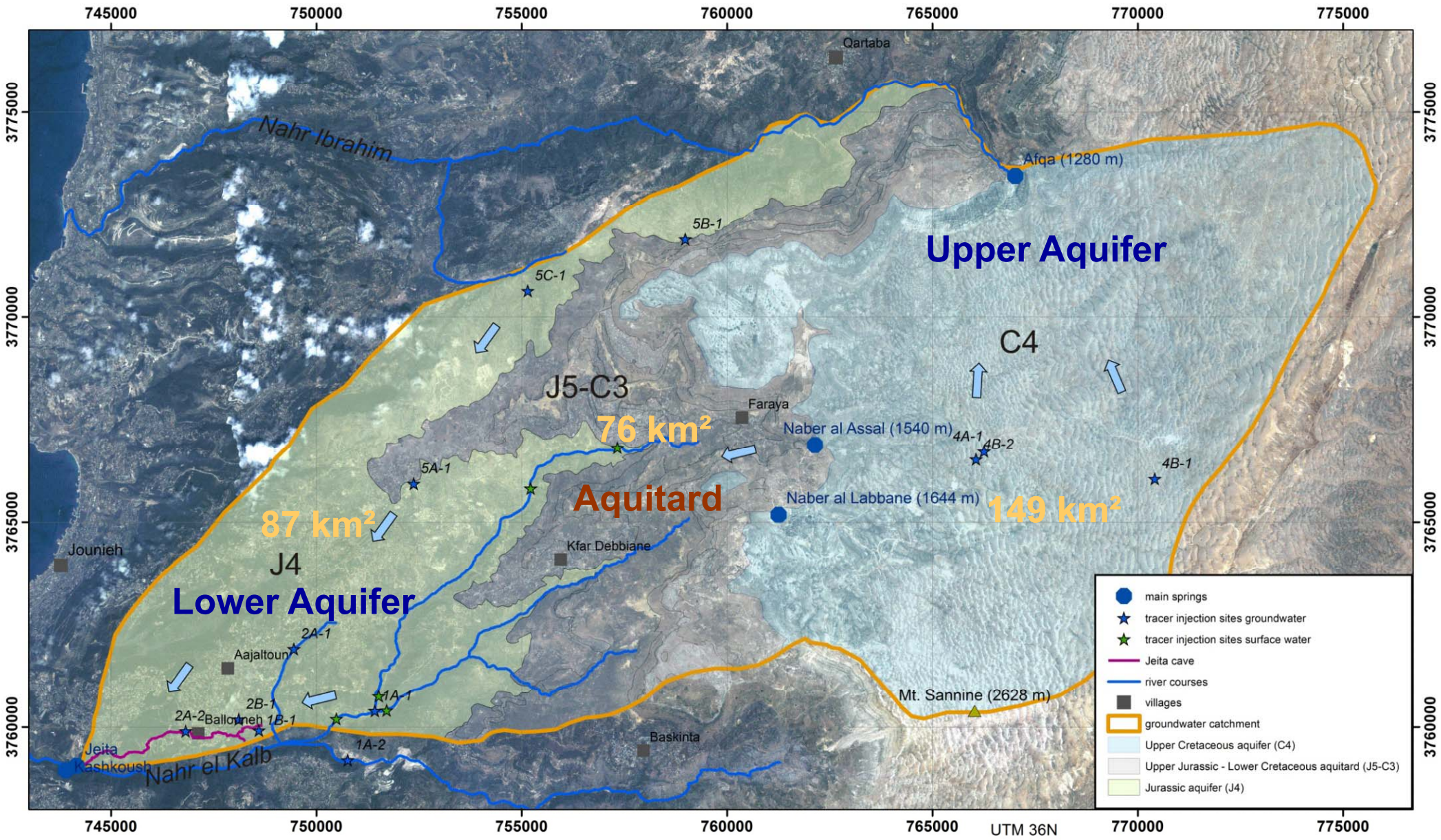
Project Area

DEM



Groundwater System

New geological map prepared by BGR



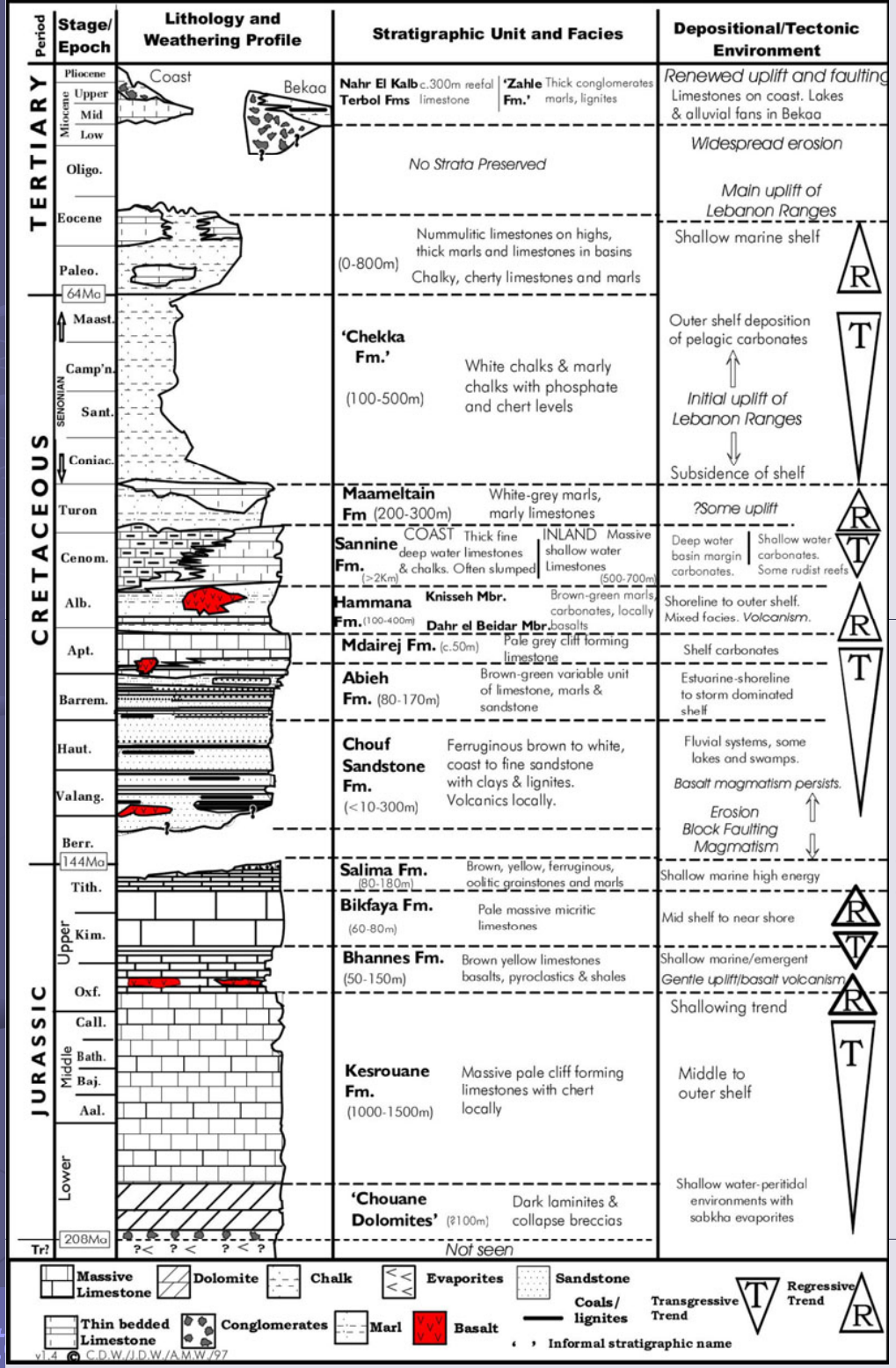
Lithostratigraphy

Upper Aquifer up to 1000 m

Aquitard 500 - 800 m

limited downward leakage

Lower Aquifer >1050 m



Source: C. D. Walley

Aquifers

C4

C3

C2b

C2a

C1

J7

J6

J5

J4

Where does Beirut's drinking water come from

Importance of Snow

Cretaceous plateau (1,800 – 3,000 m asl):
2-4 m snow (2012: up to 10 m and more)
November – May

Very important for GW recharge (~ 75%)
Snow is the lifeline of Lebanon

Climate change may lead to a significantly lower groundwater resources availability

Regional climatic scenarios predict less rainfall (15-30%), higher summer and winter temperatures (up to 5°C) and thus less snow and runoff, more evaporation

Where does Beirut's drinking water come from – Groundwater recharge

Where does Beirut's drinking water come from – Groundwater recharge

GW recharge via dolines

assumed GW recharge 75% in C4

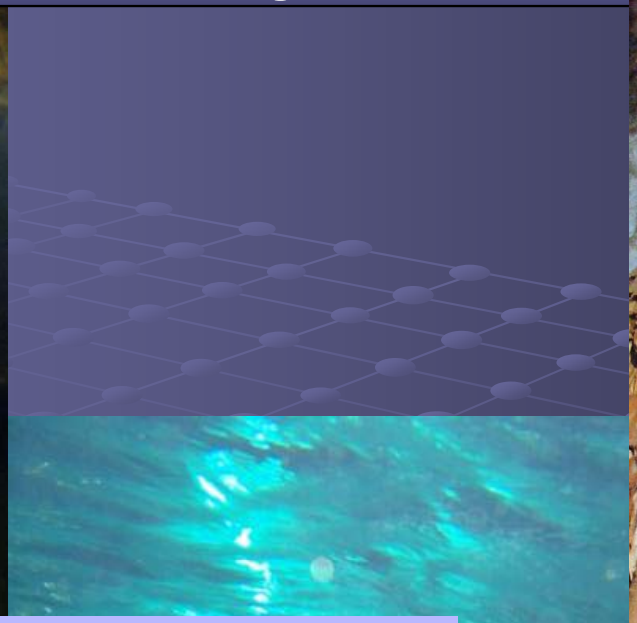
Where does Beirut's drinking water come from – Groundwater recharge

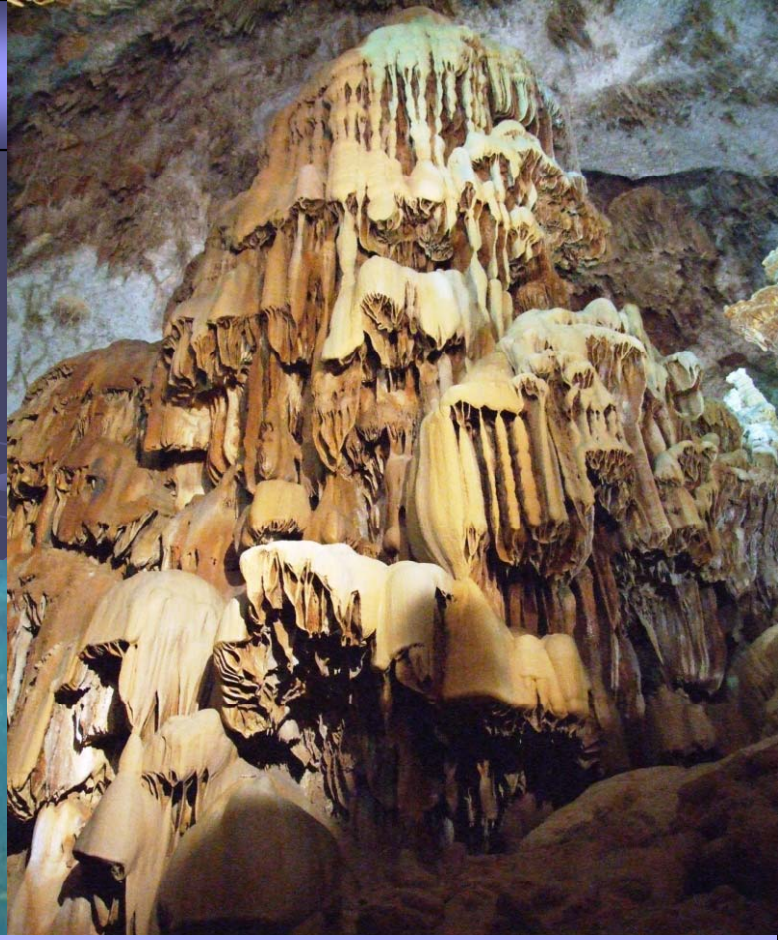
High karstification in Cretaceous limestone (Faqra)

Where does Beirut's drinking water come from – Groundwater recharge

Sinkhole

Where does Beirut's drinking water come from
Groundwater discharge





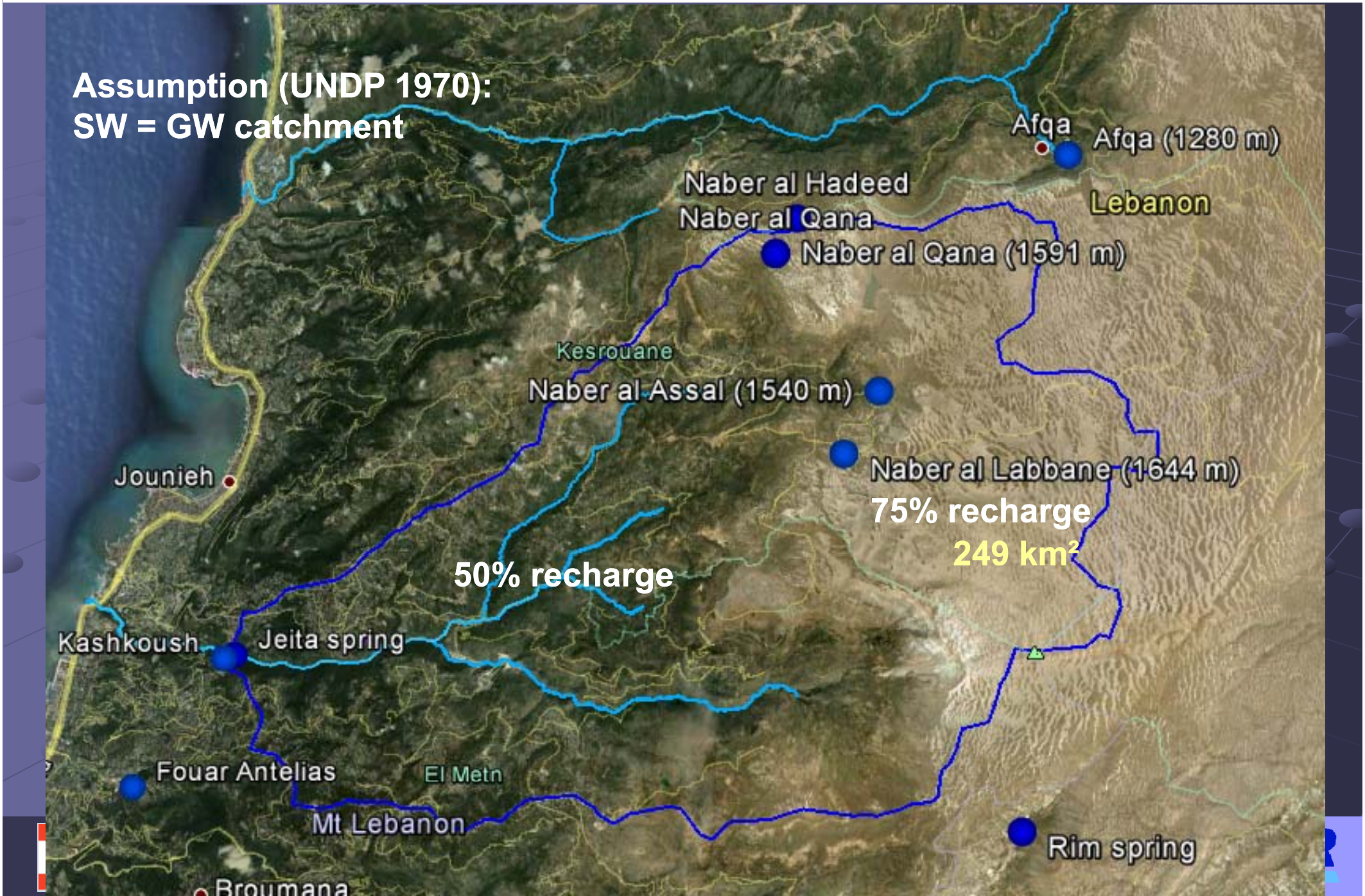
Jeita Spring
The main Source for Water Supply of Beirut

75 % of Beirut's water comes from Jeita

Awareness Movie „Beirut Waters"

Project Area = Groundwater Catchment

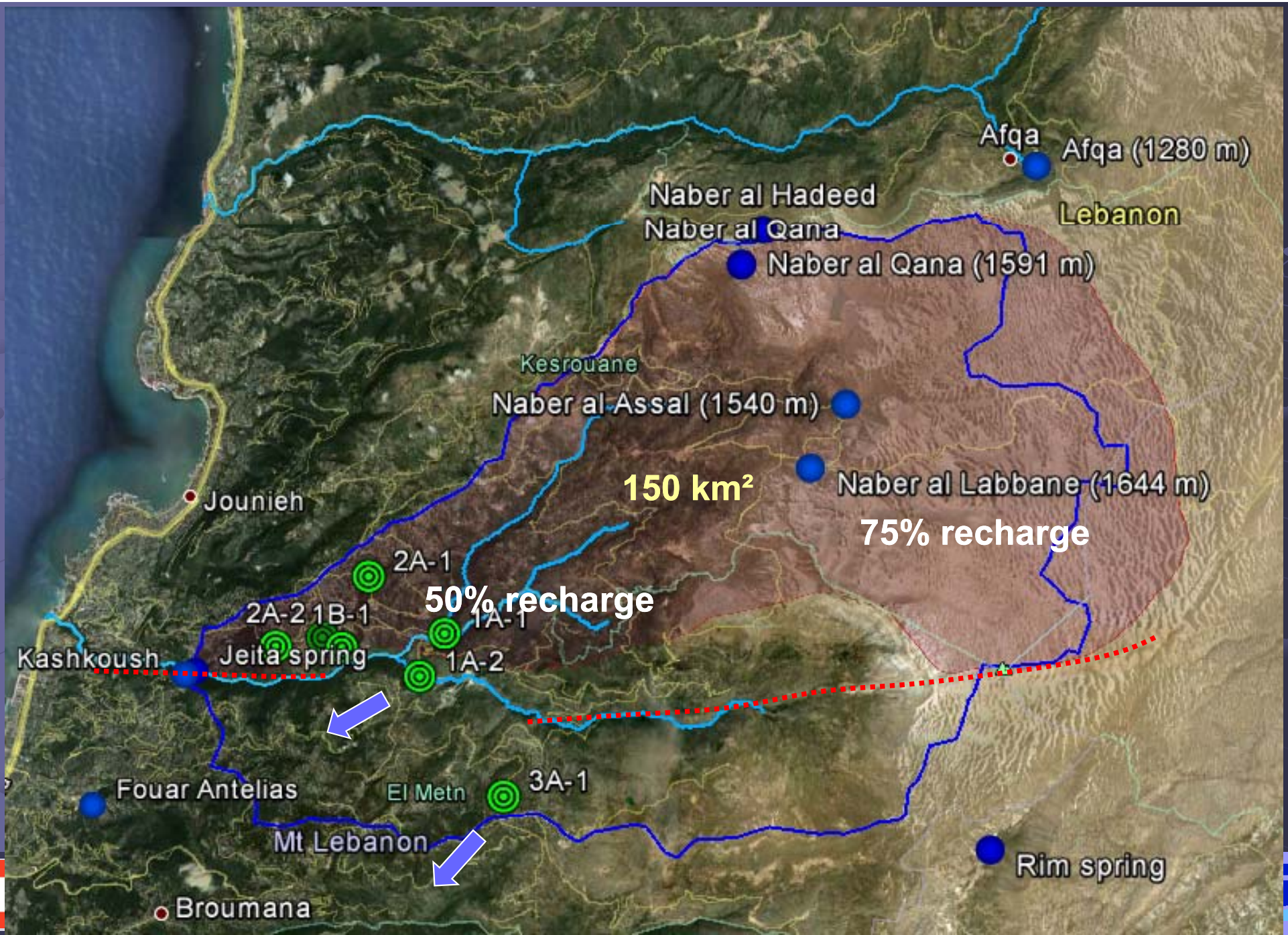
July 2010



Project Area

Tracer Tests

August 2010

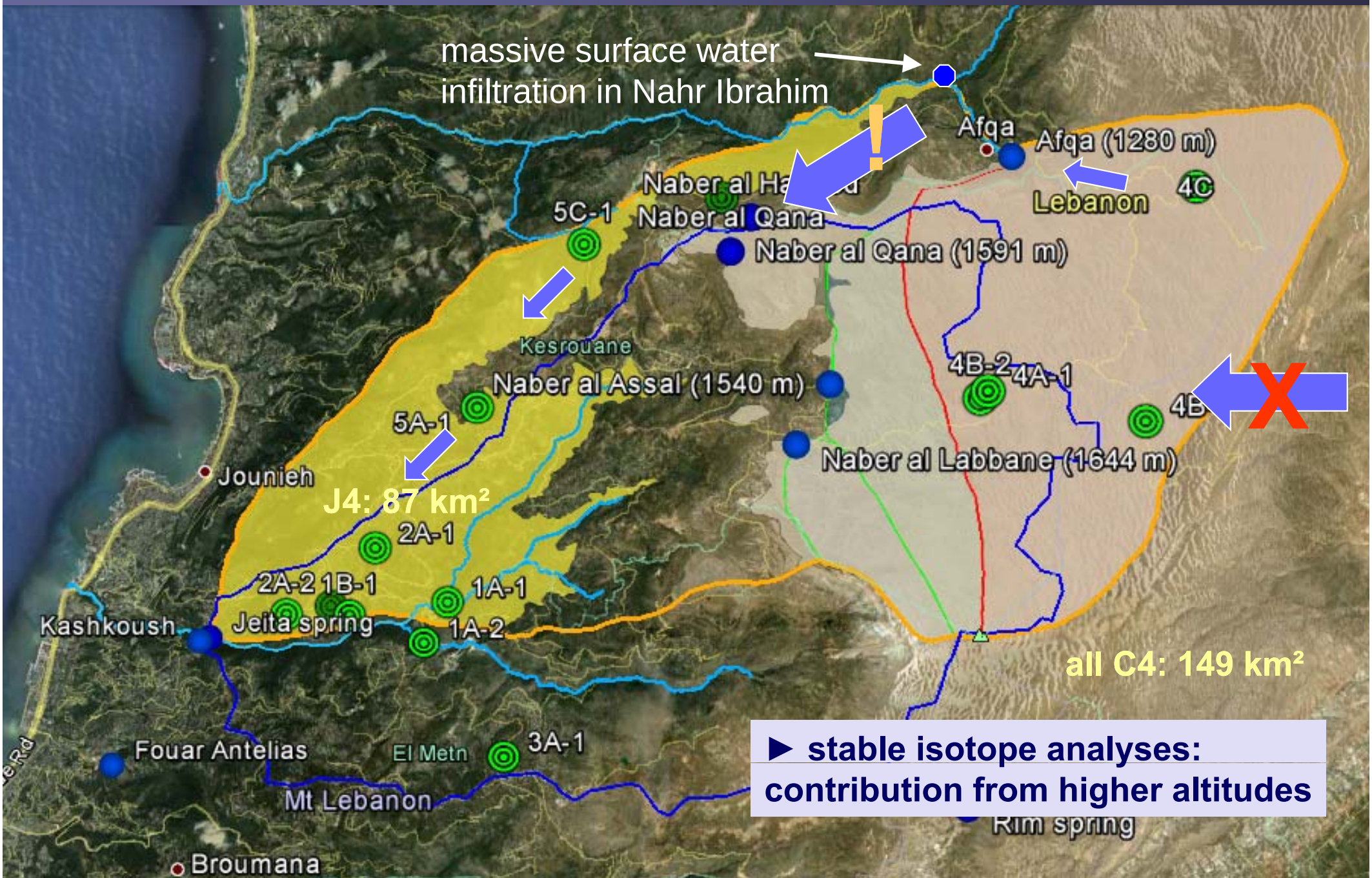


Project Area

May 2011

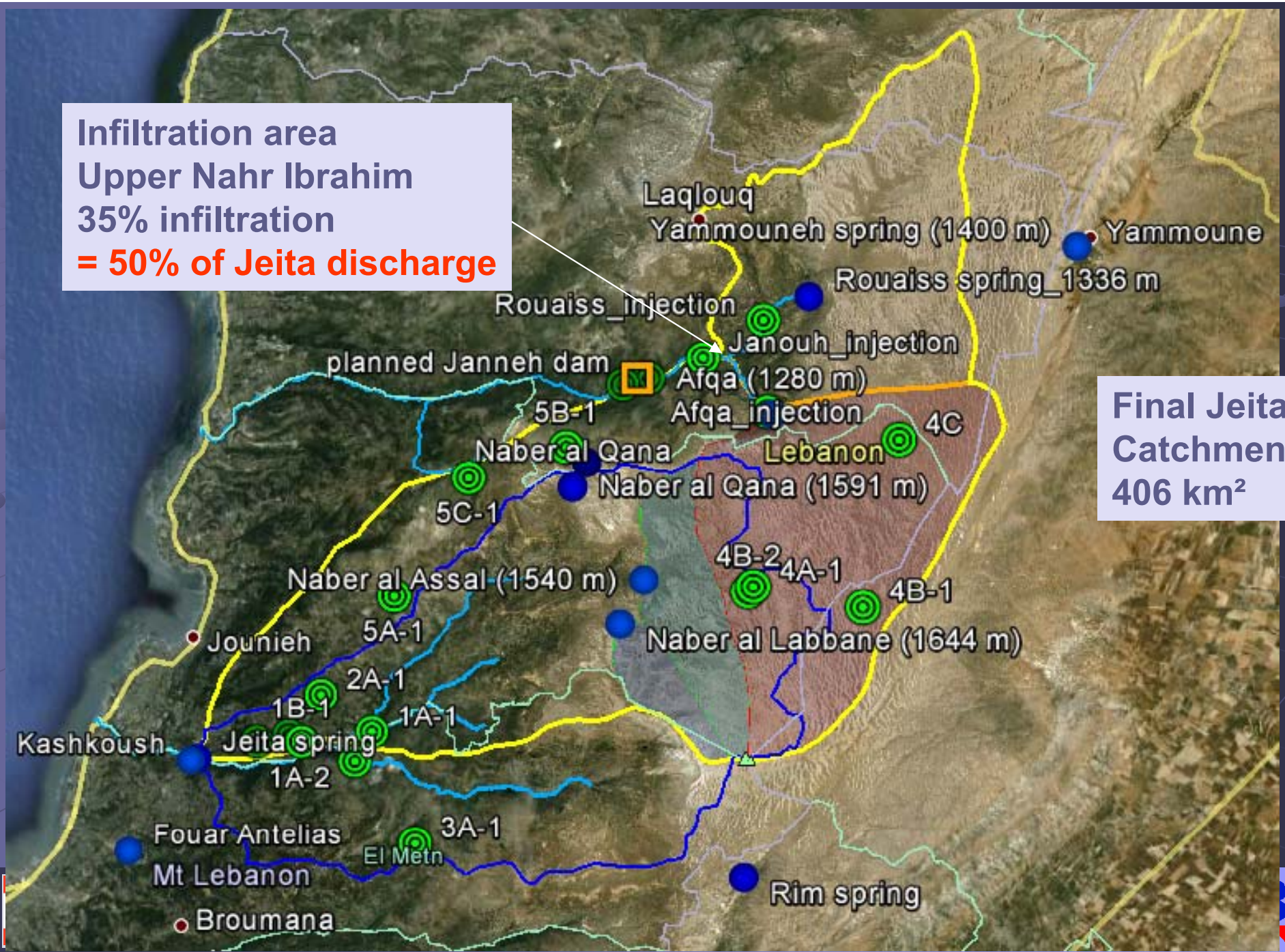
Project Area

September 2011 / April 2012



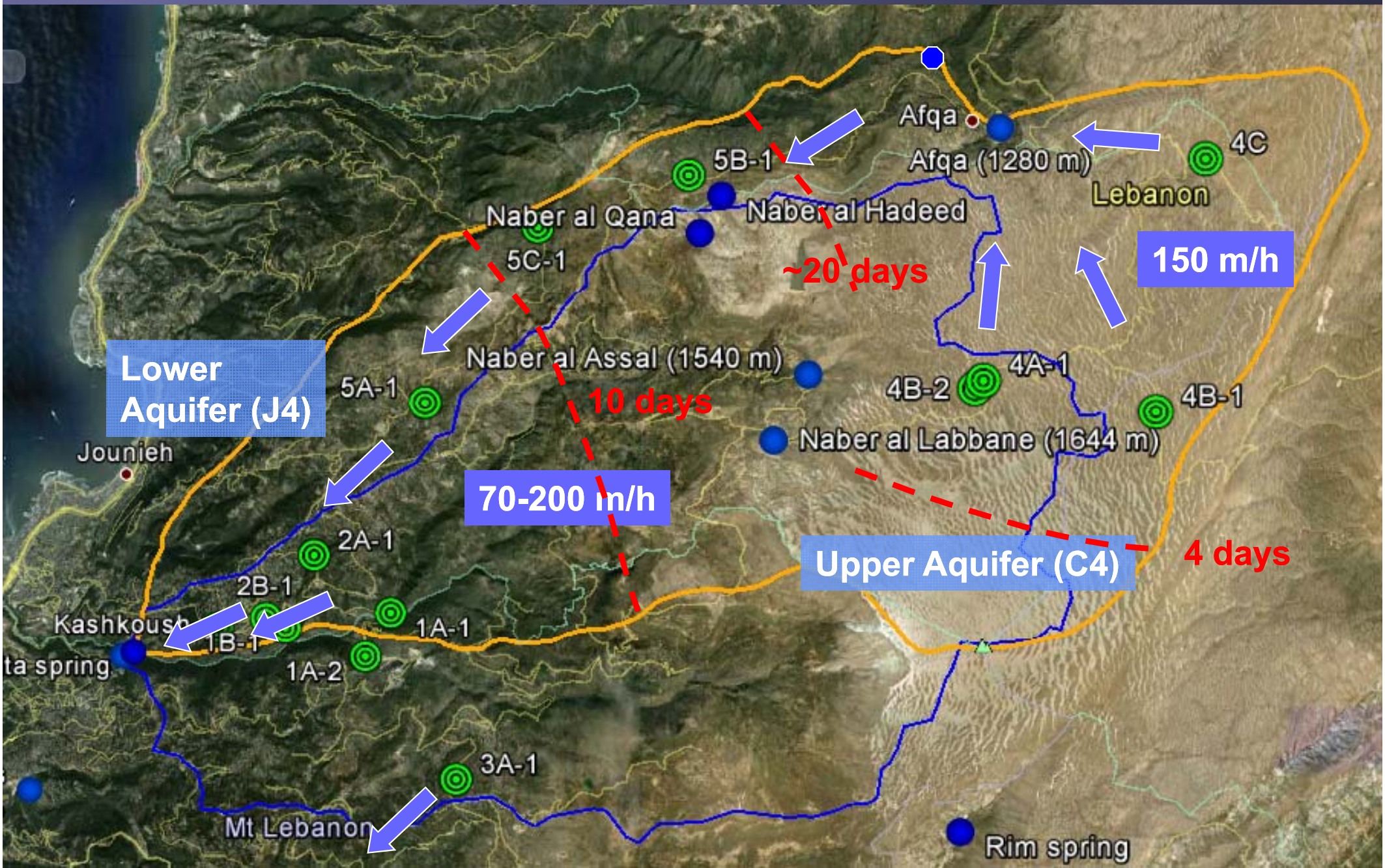
Project Area

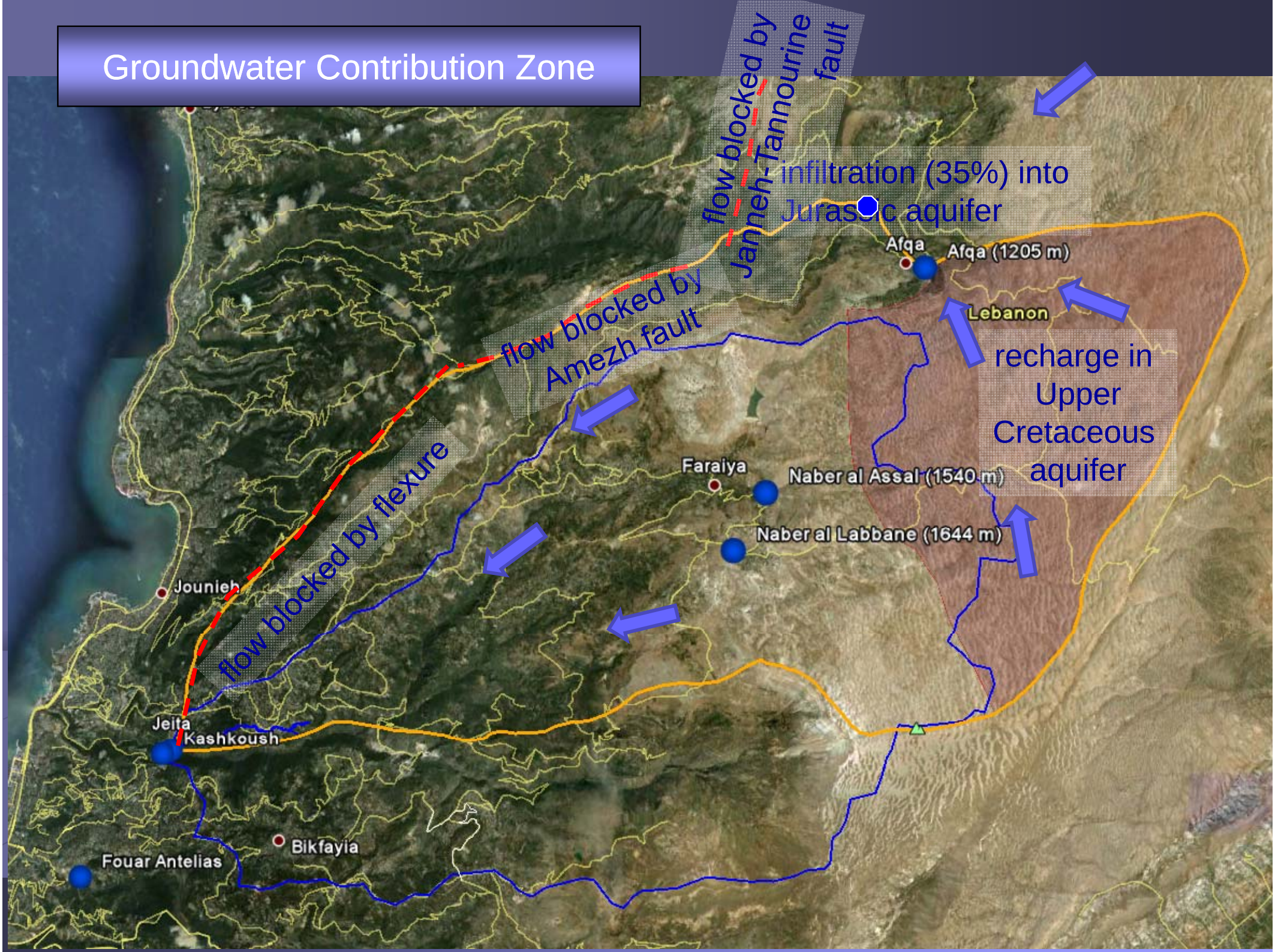
April / June 2012

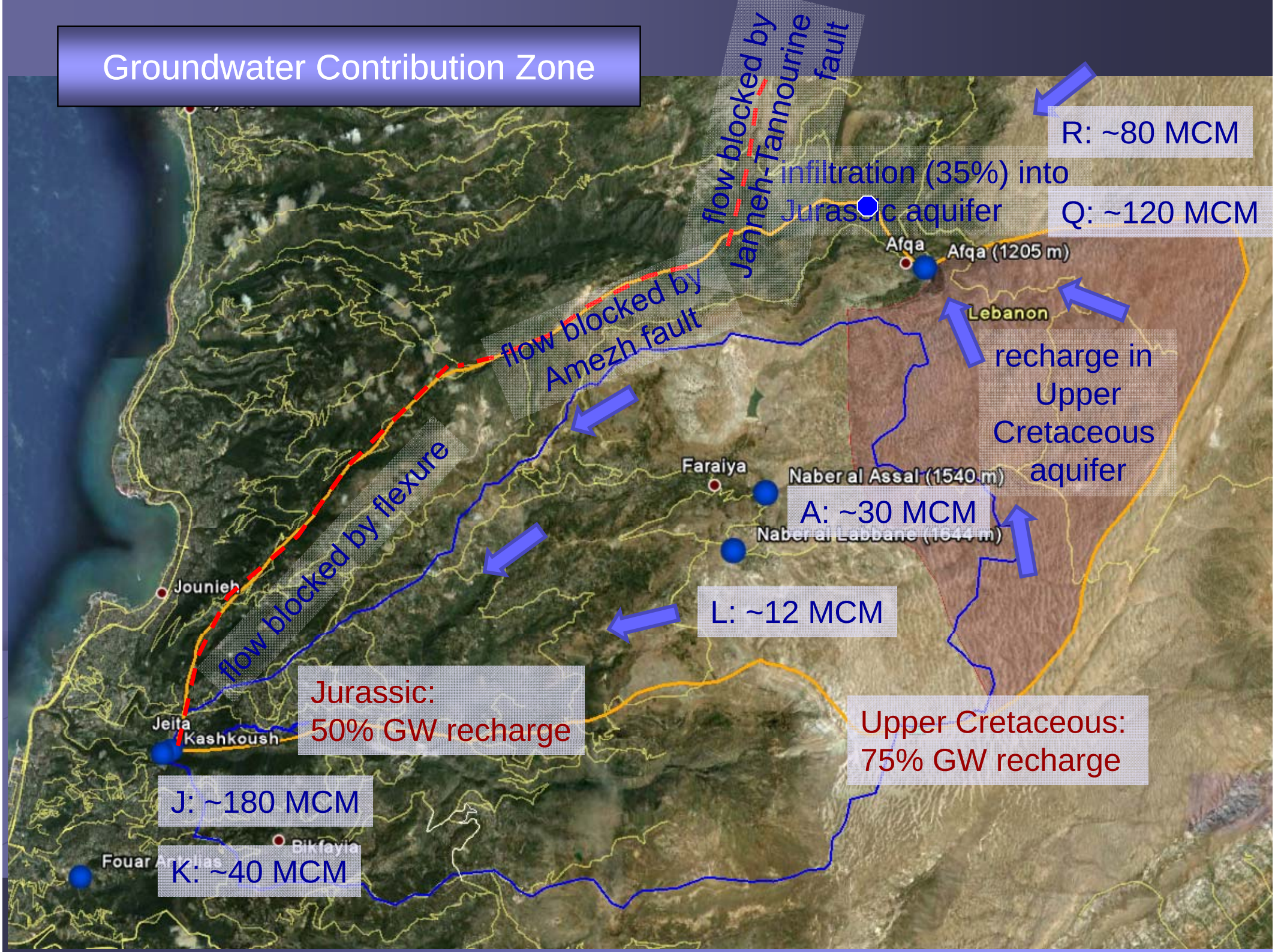


Groundwater Flow

Mean travel times

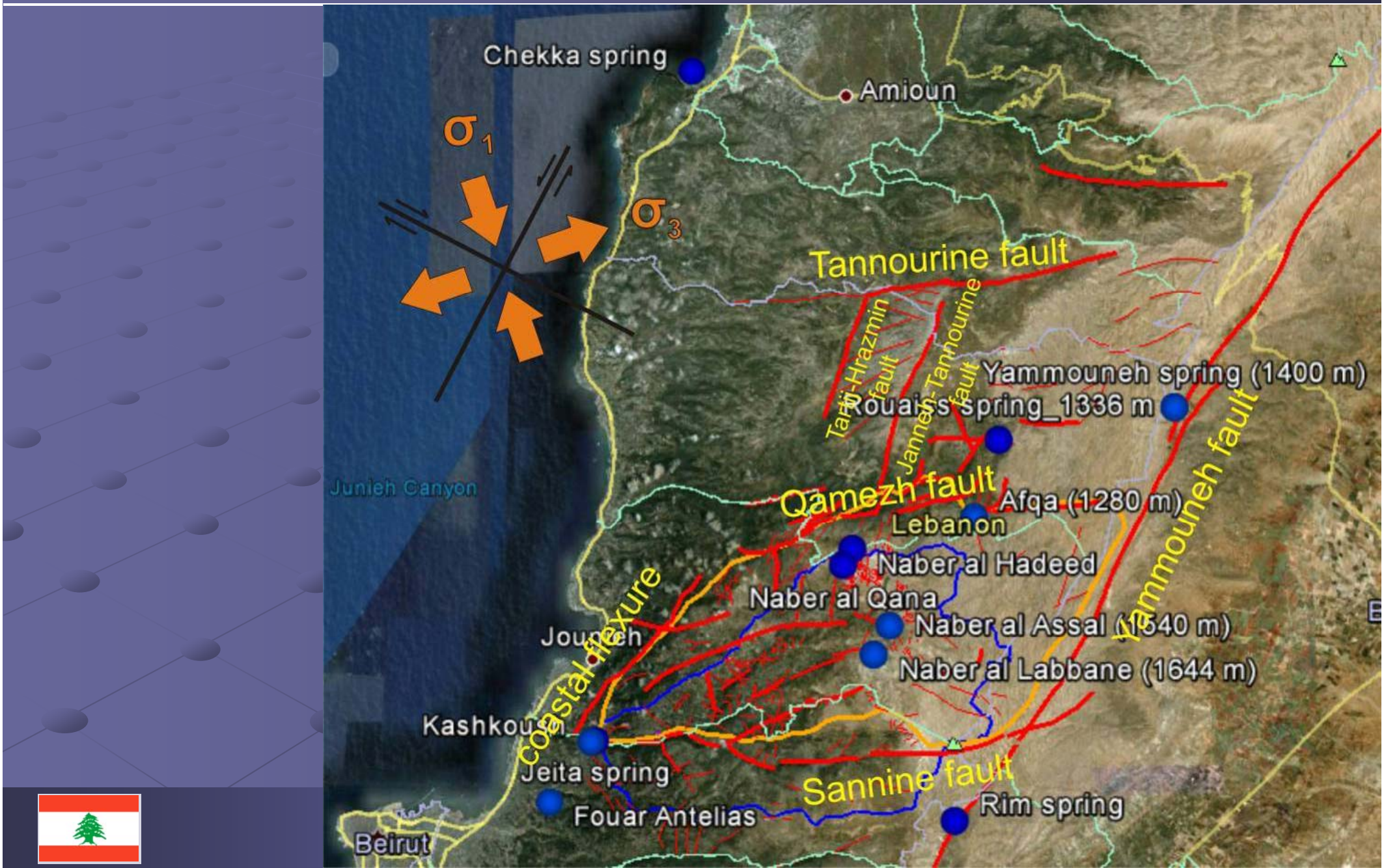



Groundwater Contribution Zone
flow blocked by Jannen-Tannourine fault
infiltration (35%) into Jurassic aquifer
Afqa
Afqa (1205 m)
Lebanon
flow blocked by Amezh fault
recharge in Upper Cretaceous aquifer
Faraiya
Naber al Assal (1540 m)
Naber al Labbane (1644 m)
flow blocked by flexure
Jounieh
Jeita
Kashkoush
Bikfayia
Fouar Antelias


Groundwater Contribution Zone
flow blocked by Jaaneh-Tannourine fault
R: ~80 MCM
infiltration (35%) into Jurassic aquifer
Q: ~120 MCM
Afqa
Afqa (1205 m)
Lebanon
flow blocked by Amezh fault
recharge in Upper Cretaceous aquifer
Faraiya
Naber al Assal (1540 m)
A: ~30 MCM
Naber al Labbane (1644 m)
flow blocked by flexure
Jounieh
L: ~12 MCM
Jurassic:
50% GW recharge
Jeita
Kashkoush
Upper Cretaceous:
75% GW recharge
J: ~180 MCM
Bikfayia
Fouar
K: ~40 MCM

Groundwater Flow

controlled by
- structure (base) and
- tectonics

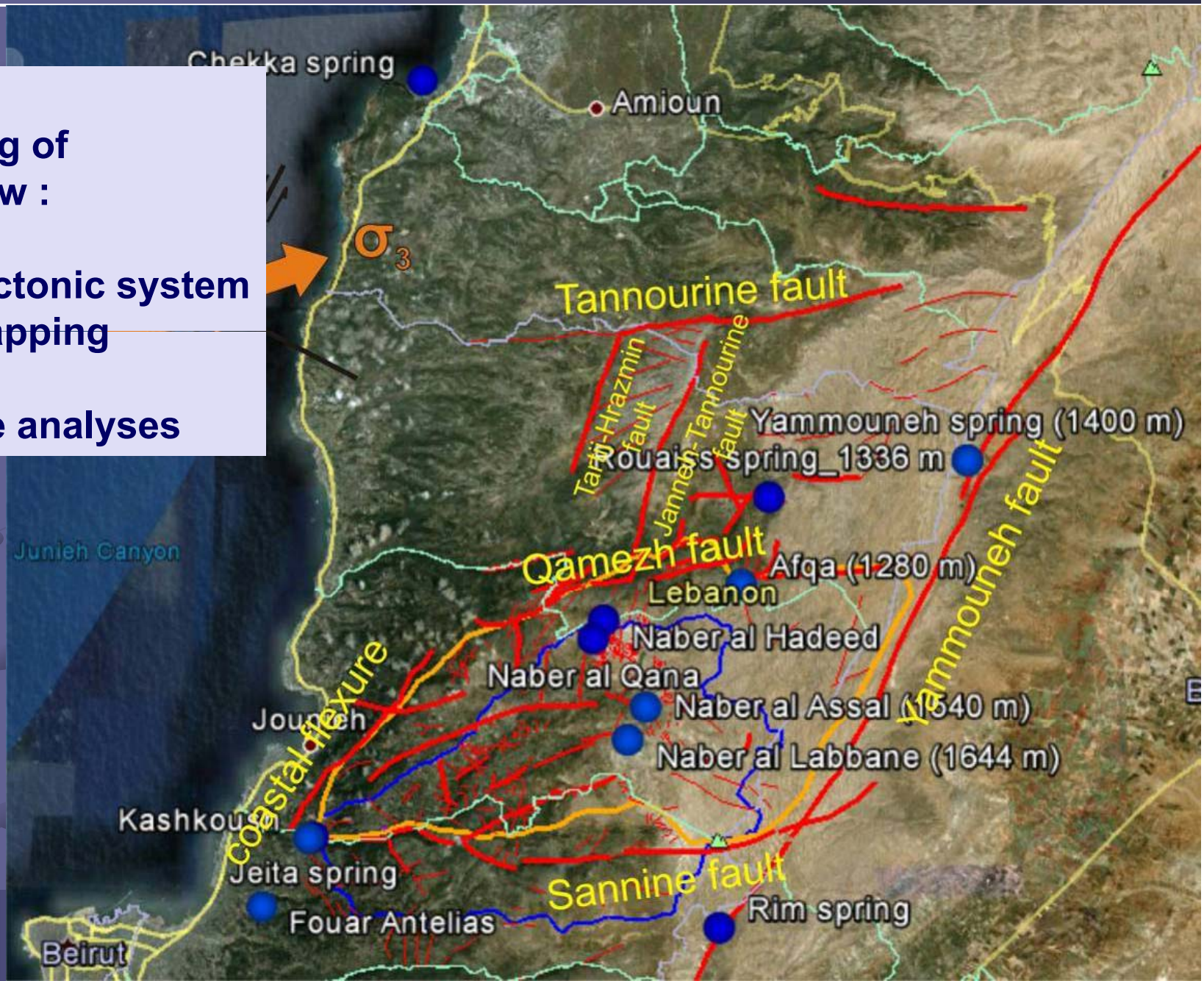


Groundwater Flow

controlled by
- structure (base) and
- tectonics

key elements to understanding of groundwater flow :

- **analysis of tectonic system**
- **geological mapping**
- **tracer tests**
- **stable isotope analyses**



Thank you for your kind attention

www.bgr.bund.de/jeita

Dr. Armin Margane – Project Team Leader
Raifoun, Saint Roche Street
armin.margane@bgr.de +961 70 398027