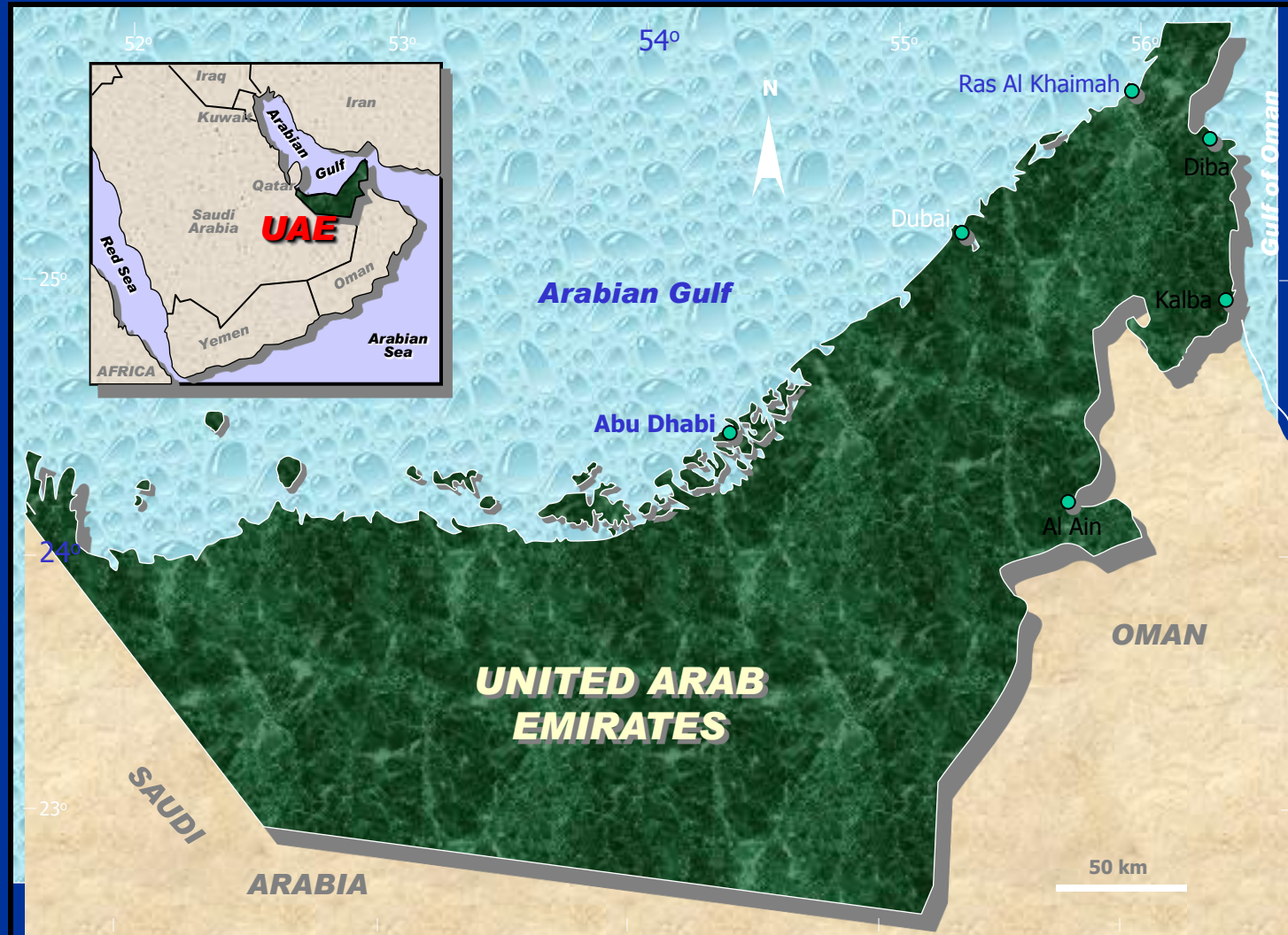


# Assessment of Artificial Groundwater Recharge in Some Wadies in UAE by using Isotope Hydrology Techniques

Presented by :  
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Ministry of Environment & Water U.A.E

Prepared for :  
**The 8<sup>th</sup> Gulf Water Conference**  
**Manama – Bahrain**  
**3 – 6 March 2008**

# Location map of the United Arab Emirates





# Climate

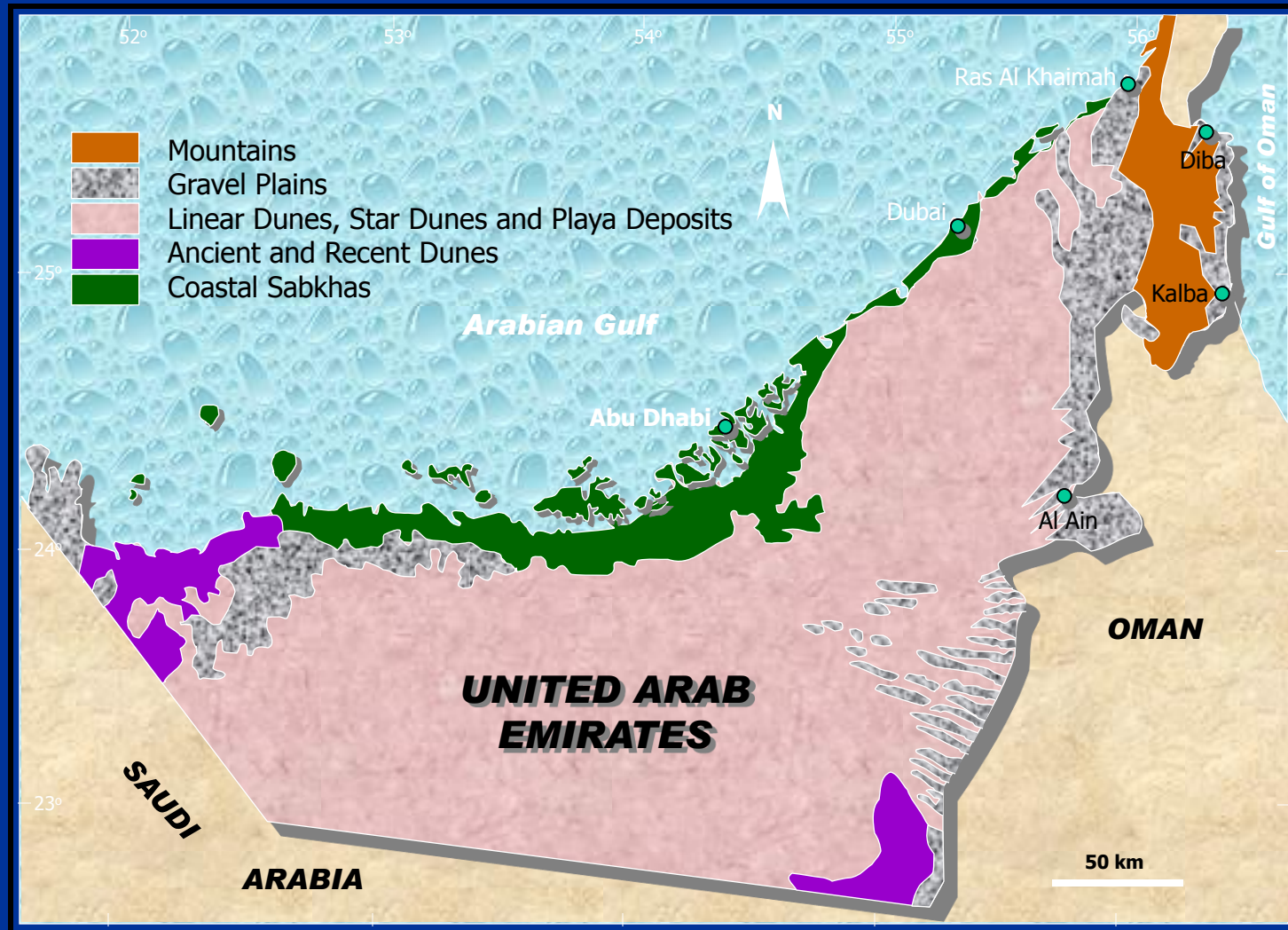
The UAE has an arid to semi-arid climate with high temperature and infrequent irregular low rainfall .

- Mean max. temperature reach  $> 40^{\circ}\text{C}$  in summer .
- High relative humidity ( reaches  $> 97\%$  ) .
- Average daily evaporation 8.2 mm .
- Average annual mean rainfall is around 115 mm .

# **GEOMORPHOLOGY AND GEOLOGY**

The geomorphic features have a major role in controlling the movement of both surface and groundwater. Geology, on the other hand, encompasses the distribution of outcrops, stratigraphic sequences, and structural zones. These greatly influence runoff volumes, infiltration rates and surface and groundwater quality. The following discussion outlines the main geomorphic features in UAE, geologic setting, and structural elements.

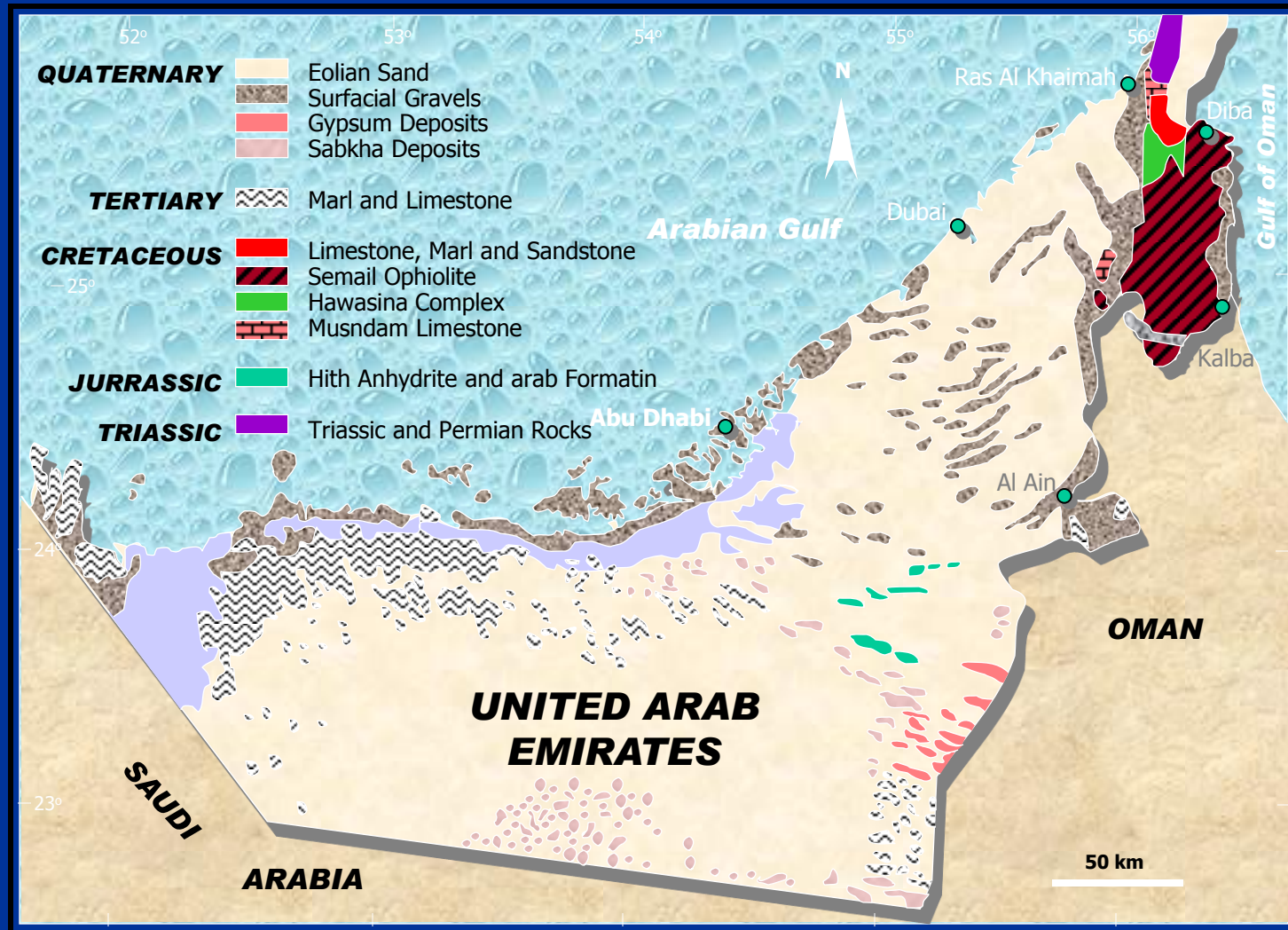
# The Main Geomorphic Features in the UAE



## Geologic Setting

- The northern Oman Mountains in UAE are composed of two major classes of rocks . The first is an autochthonous sequence including Proterozoic basement rocks and some early Paleozoic sediments covered transgressively by carbonate platform deposits ranging in age from late Permian to late Cretaceous, and two allochthonous sequences. The lower sequence is composed of sedimentary rocks and is known as the Hawaina Group. This sequence is overlain by the Semail Suite, which consists of a slab of former oceanic crust . The Maastrichtian to Neogene sediments was laid down after the main episode of nappe emplacement. The actual relief of the Oman Mountains is due to tectonic movements that occurred during “post-nappes” times, i.e. during the Cenozoic. These movements resulted in the uplifting of the mountains.

# Geologic Map of the United Arab Emirates





# Geologic Structure

The UAE can be differentiated into five structural provinces, from north to south, including: Ru'us Al Gibal, Diba zone, ophiolite sequence, wadi Hatta zone, and the western area .

Ru'us Al Gibal area is characterized by thrust faults that are inclined in the east and south directions. Sometimes the thrust plain slopes towards east to the zone of overturned and recumbent folds.

The Diba zone is a topographically low and extends for 30 km from northeast to southwest, with an average width of 20 km.



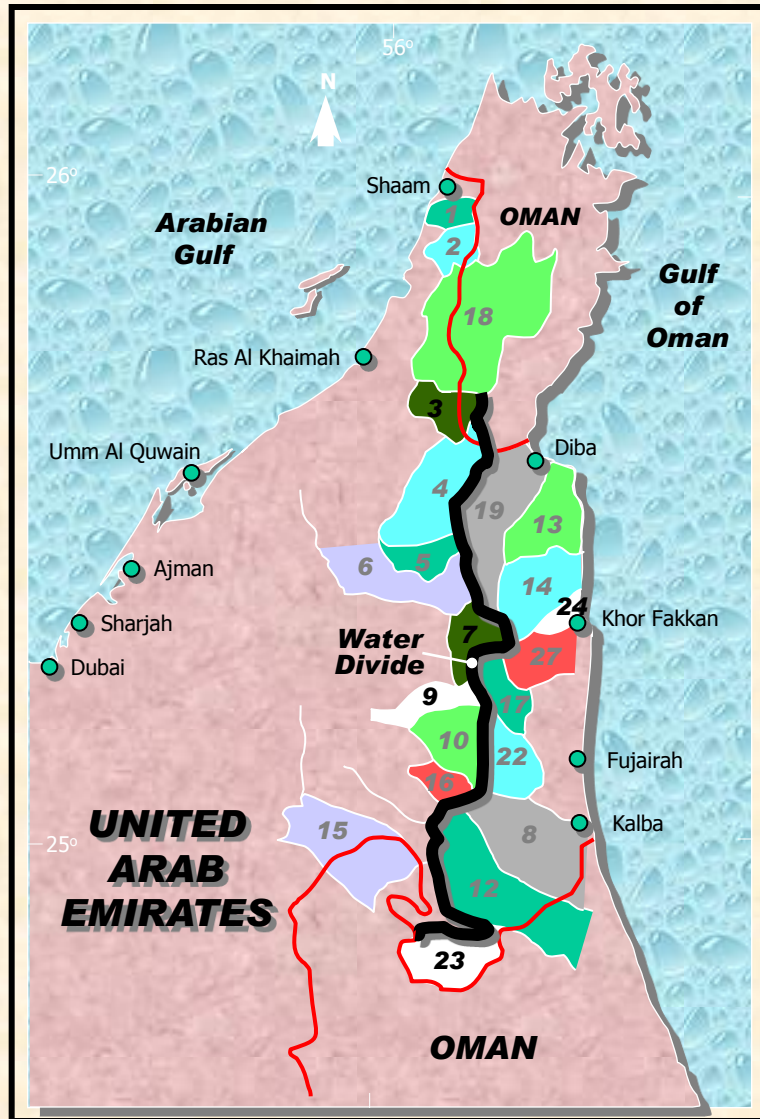
## **Geologic Structure**

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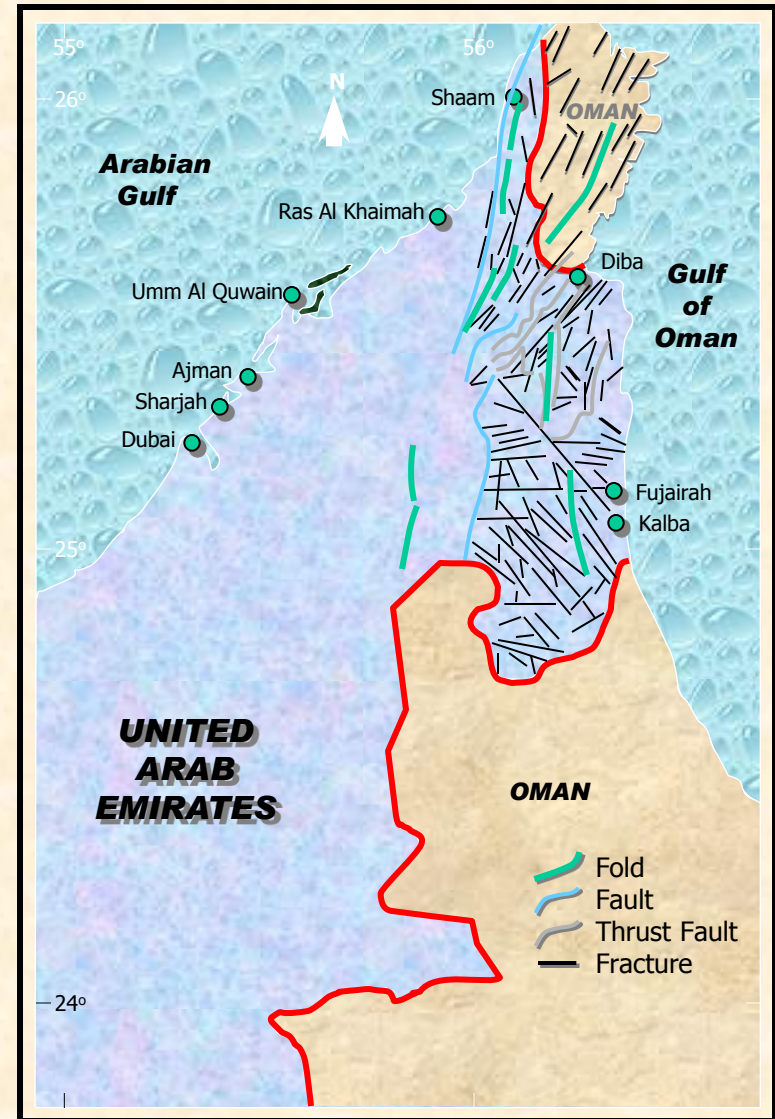
**Ru'us Al Gibal area is characterized by thrust faults that are inclined in the east and south directions. Sometimes the thrust plain slopes towards east to the zone of overturned and recumbent folds.**

**The Diba zone is a topographically low and extends for 30 km from northeast to southwest, with an average width of 20 km.**

# Major Drainage Basins



# Main Geologic Structures



# Water Resources

## > Conventional

- Surface runoff : 25 main wadies with average runoff 185 MCM  
Groundwater : The groundwater is main resource for agriculture.  
Renewable : shallow alluvial aquifers ( gravel plains ) .  
Non-renewable (fossil ) : deep aquifers ( sedimentary rocks ).  
Falajes & Springs : Annual discharge 20 MCM .

## > Non - conventional

- Desalinated Water : Total capacity 1370 MCM / y  
Sewage Recycled Water : Total capacity 309 MCM / y

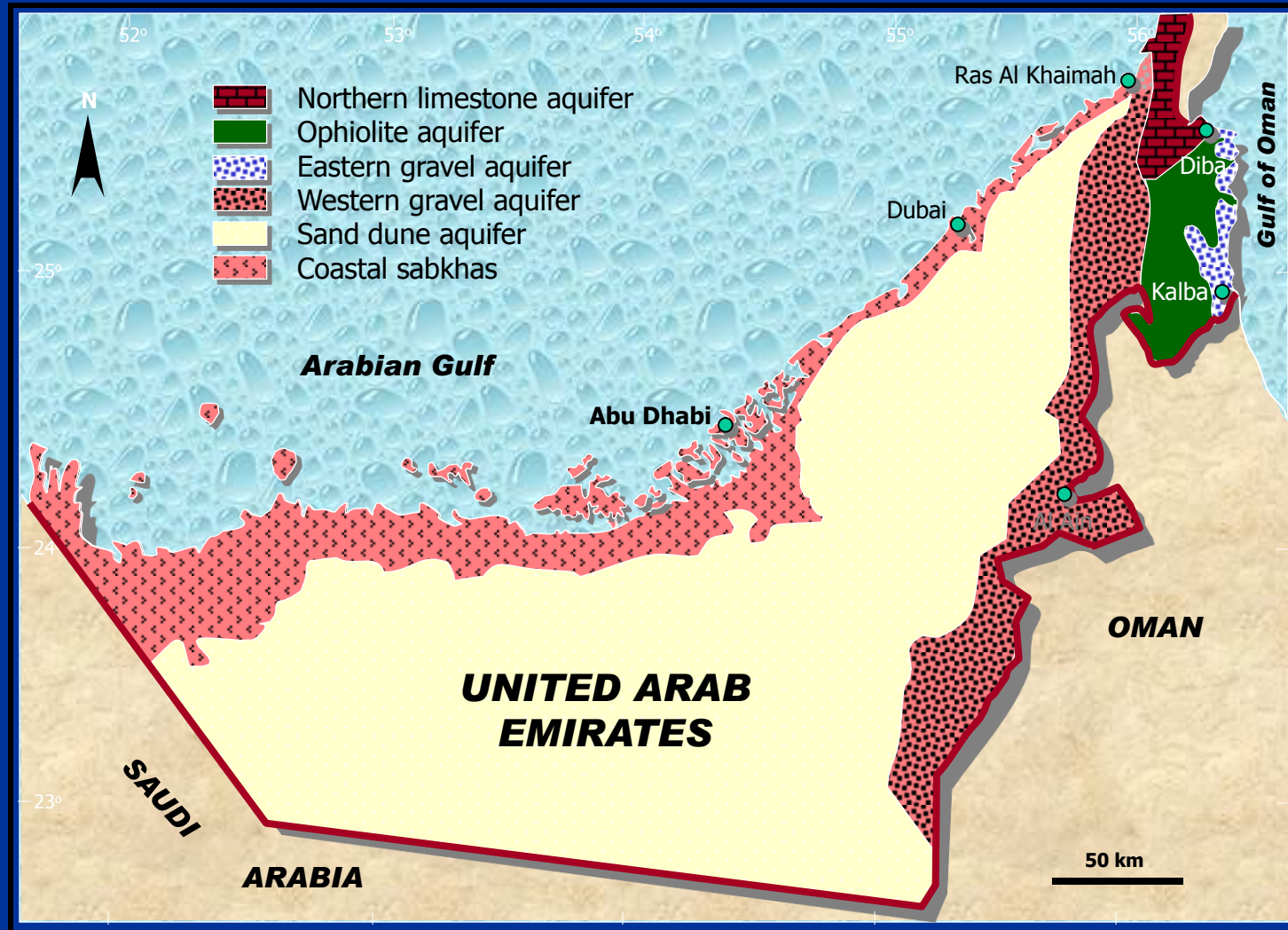




## **The main aquifers in the UAE include :**

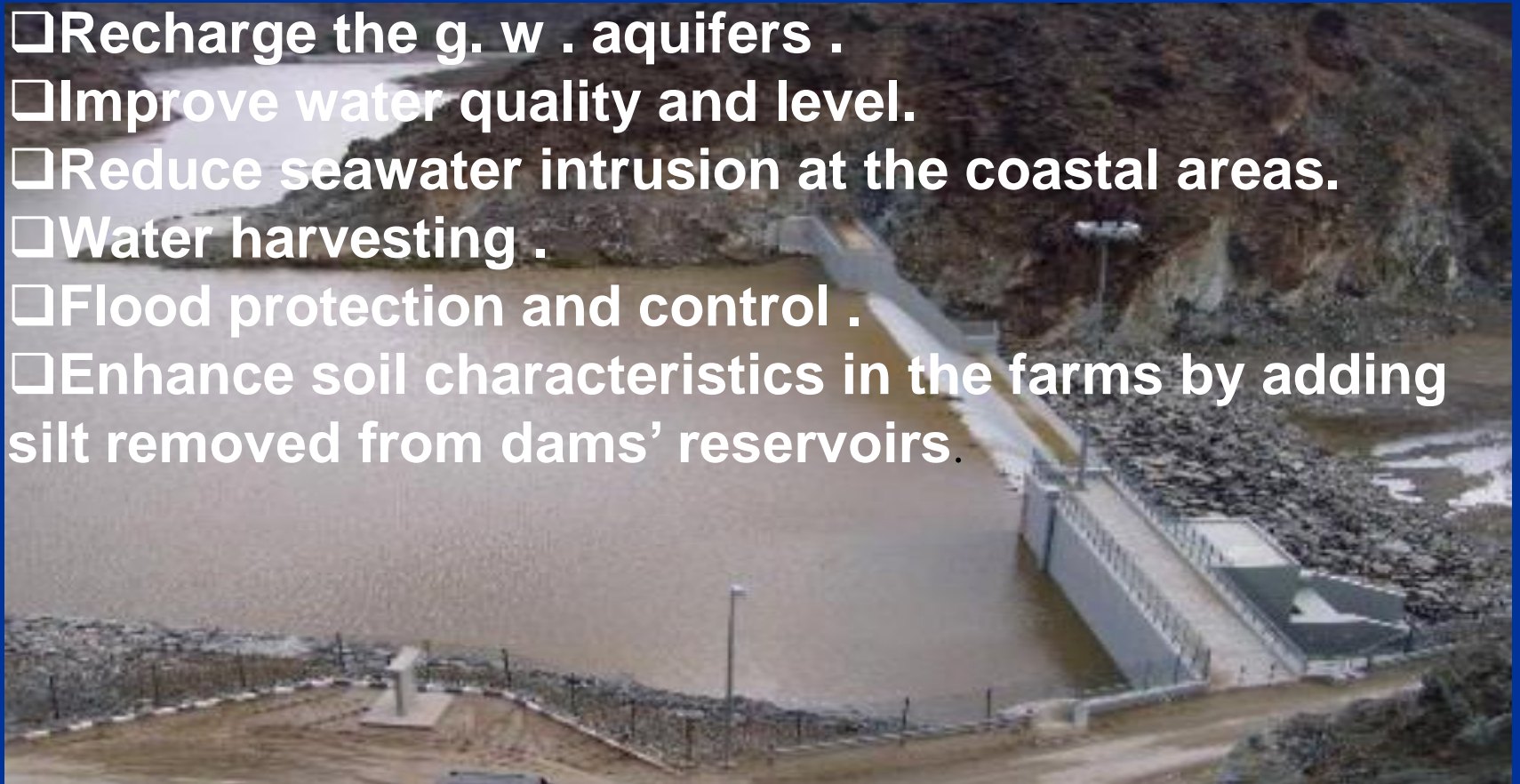
- **Limestone aquifer in the North and East.**
- **Fractured ophiolite group in the East .**
- **Gravel aquifers flanking the Eastern Mountain ranges on the East and West.**
- **Sand dunes aquifers in the South and West.**

# The Main Aquifers in the United Arab Emirates



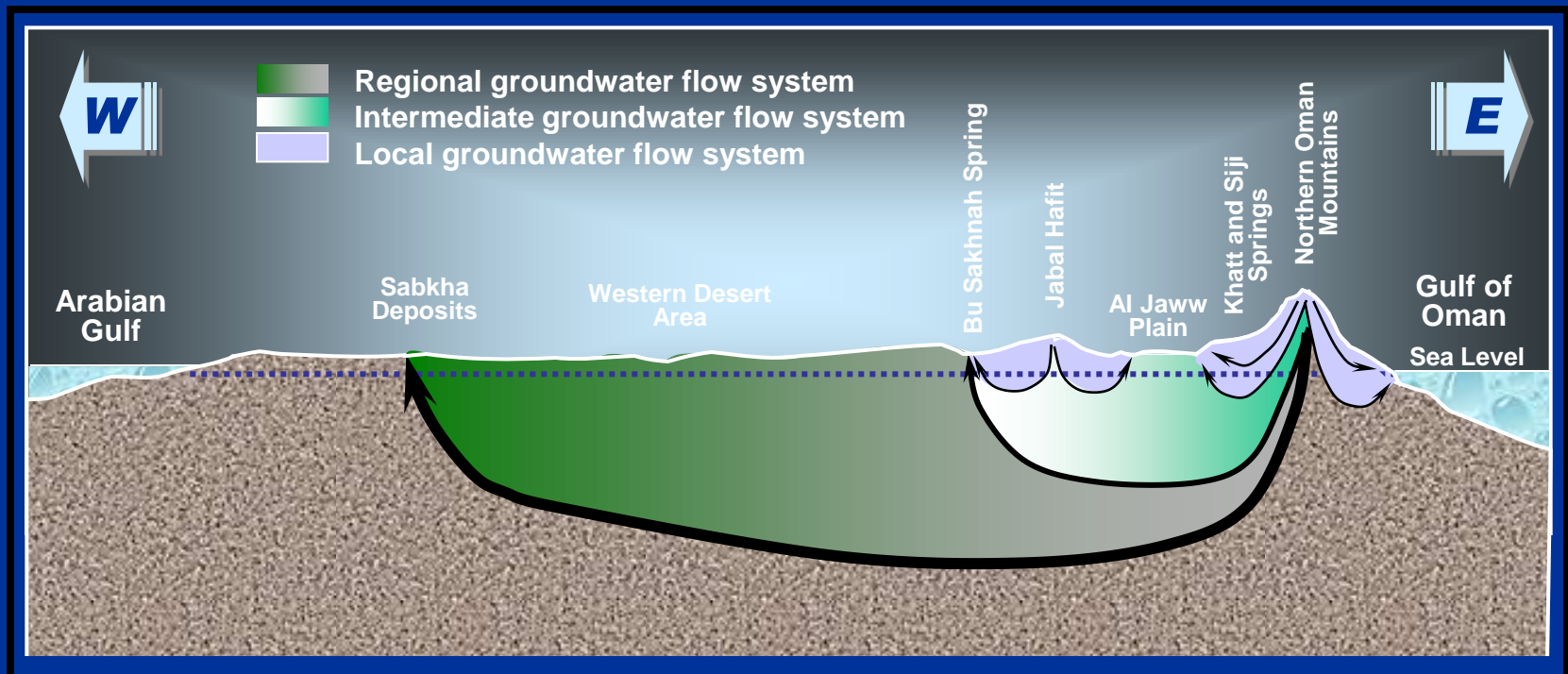
The main objective of Dams construction project is to retain surface runoff in the wadies which is going losses to the sea , and achieve :

- ❑ Recharge the g. w . aquifers .
- ❑ Improve water quality and level.
- ❑ Reduce seawater intrusion at the coastal areas.
- ❑ Water harvesting .
- ❑ Flood protection and control .
- ❑ Enhance soil characteristics in the farms by adding silt removed from dams' reservoirs.





# Groundwater Flow Systems in UAE



# Wurrayah Dam

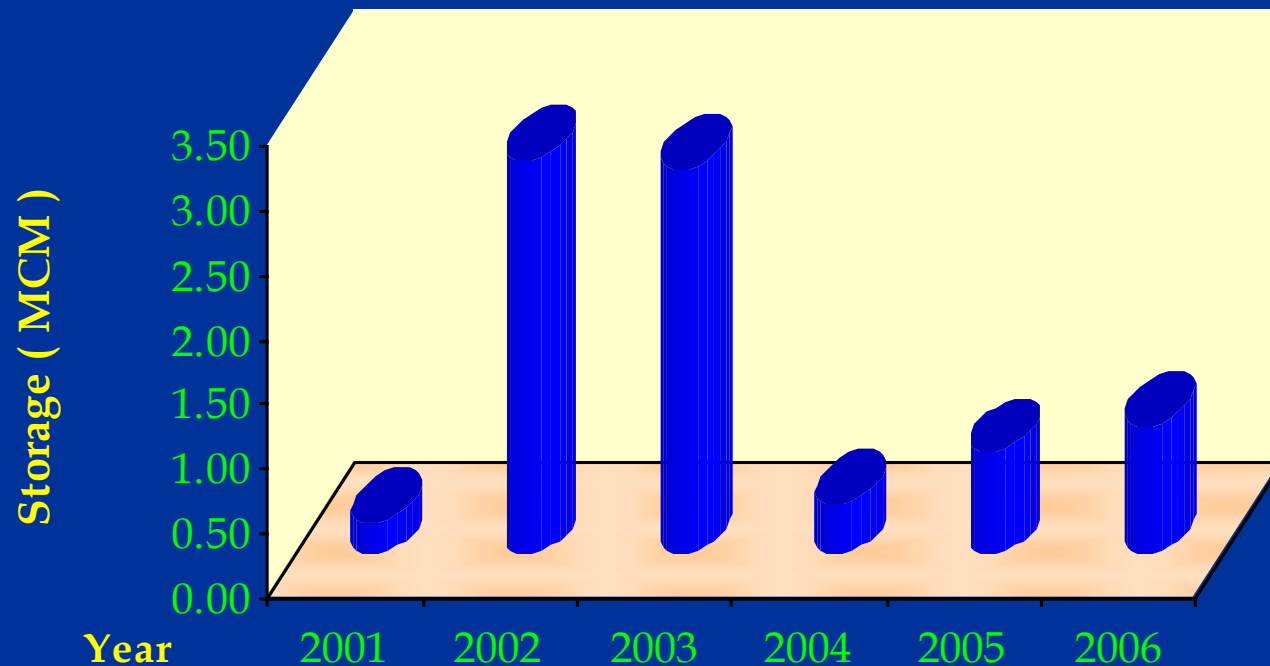


**Al Matri A. S. 2008**

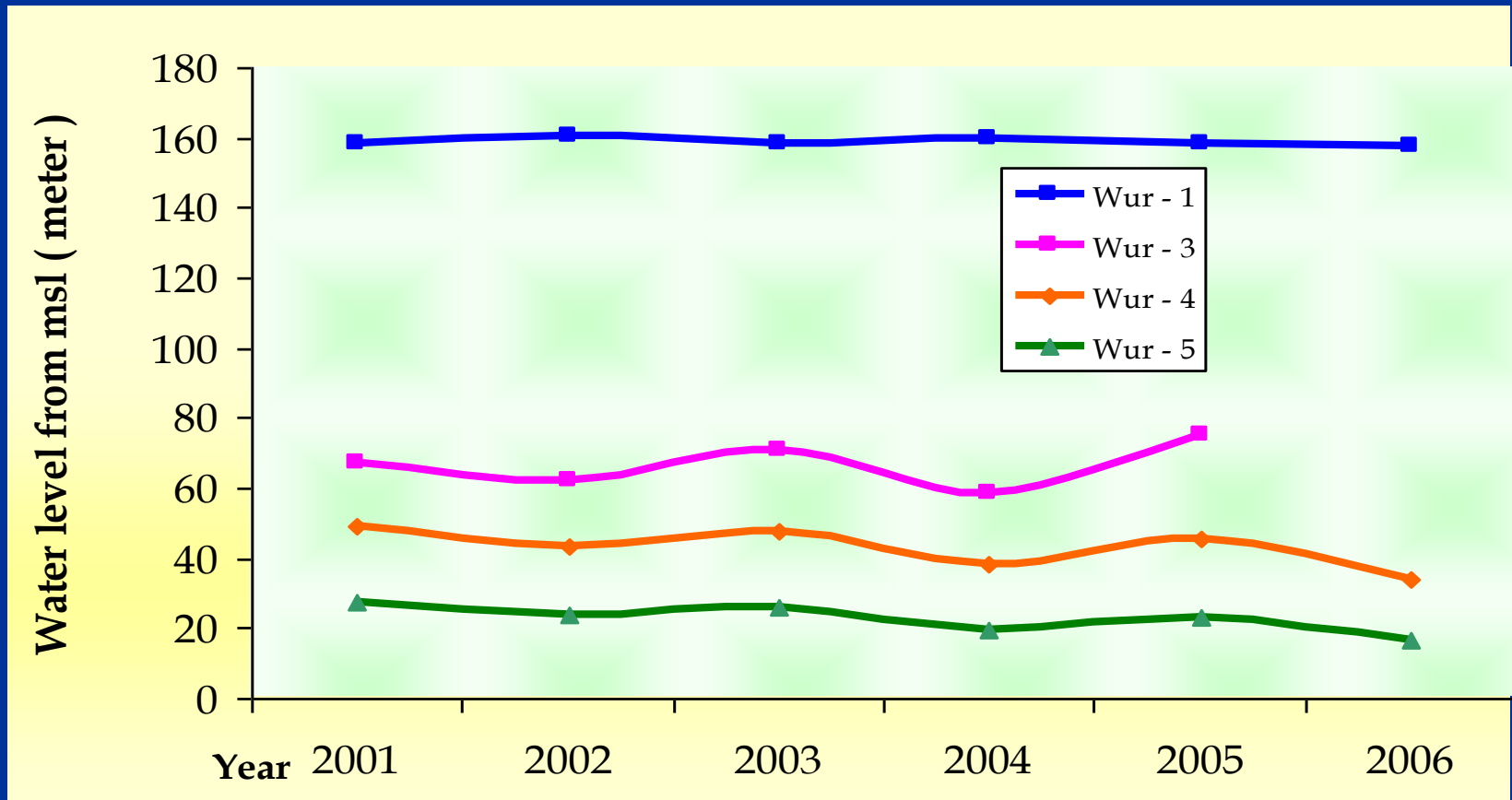
<b>Dam Location</b>	<b>Wadi Wurrayah – Fuj.</b>
<b>Completion Date</b>	<b>December 1997</b>
<b>Dam Purpose</b>	<b>Groundwater Recharge and Flood Protection</b>
<b>Reservoir Capacity</b>	<b>5.2 million cubic meters</b>
<b>Dam Type</b>	<b>Earth – Rock Fill</b>
<b>Dam Height</b>	<b>33 meter</b>
<b>Dam Length</b>	<b>150 meter</b>
<b>Benefited Area</b>	<b>Khor fakkan , Bedyah</b>



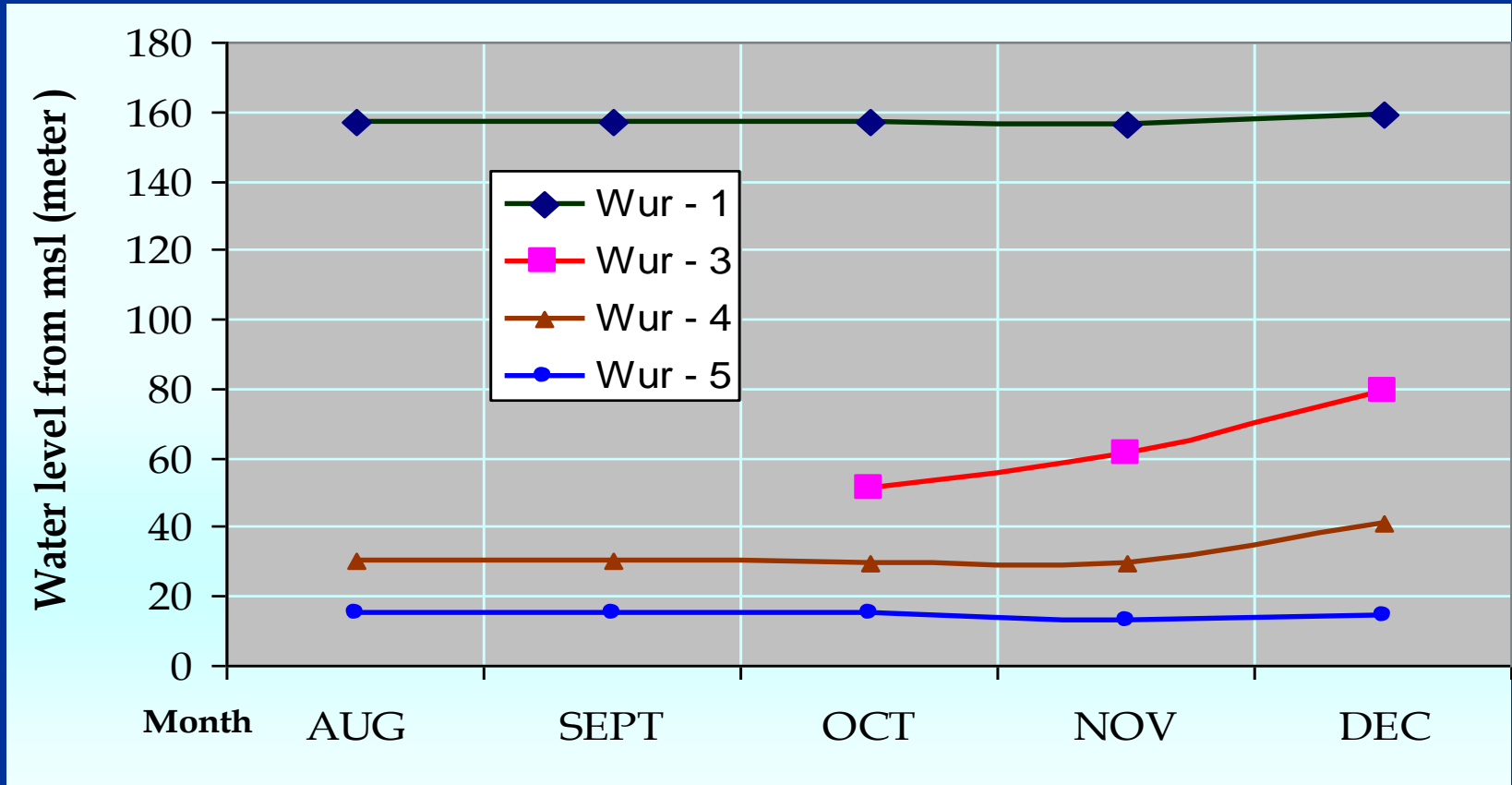
# Water storage in Wur Dam during the period 2001 - 2006



# Mean annual variation in groundwater level for some observation wells in Wurrayah

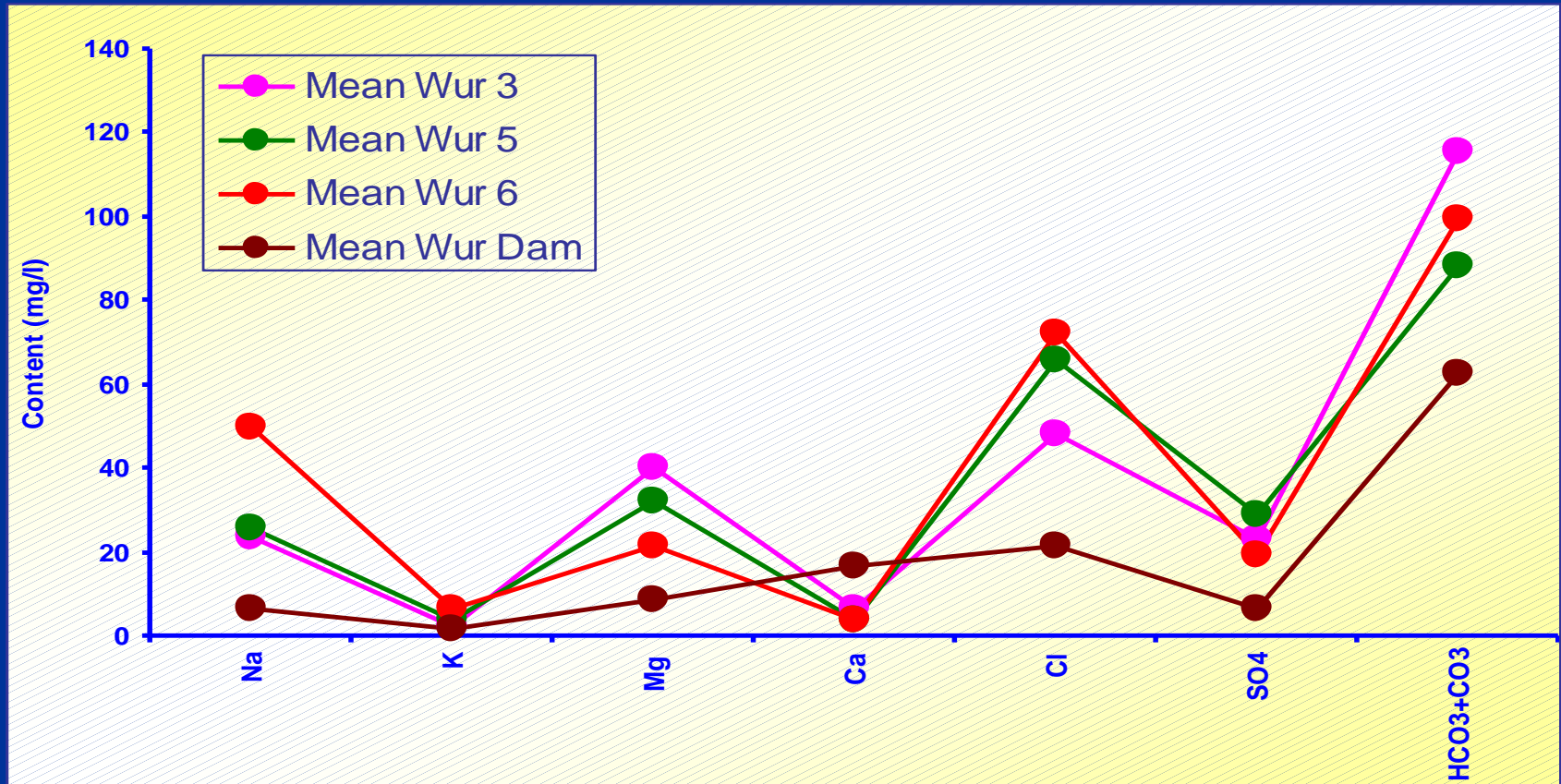


## Ground water level variation during rain season ( 2007 ) for some observation wells in Wurrayah

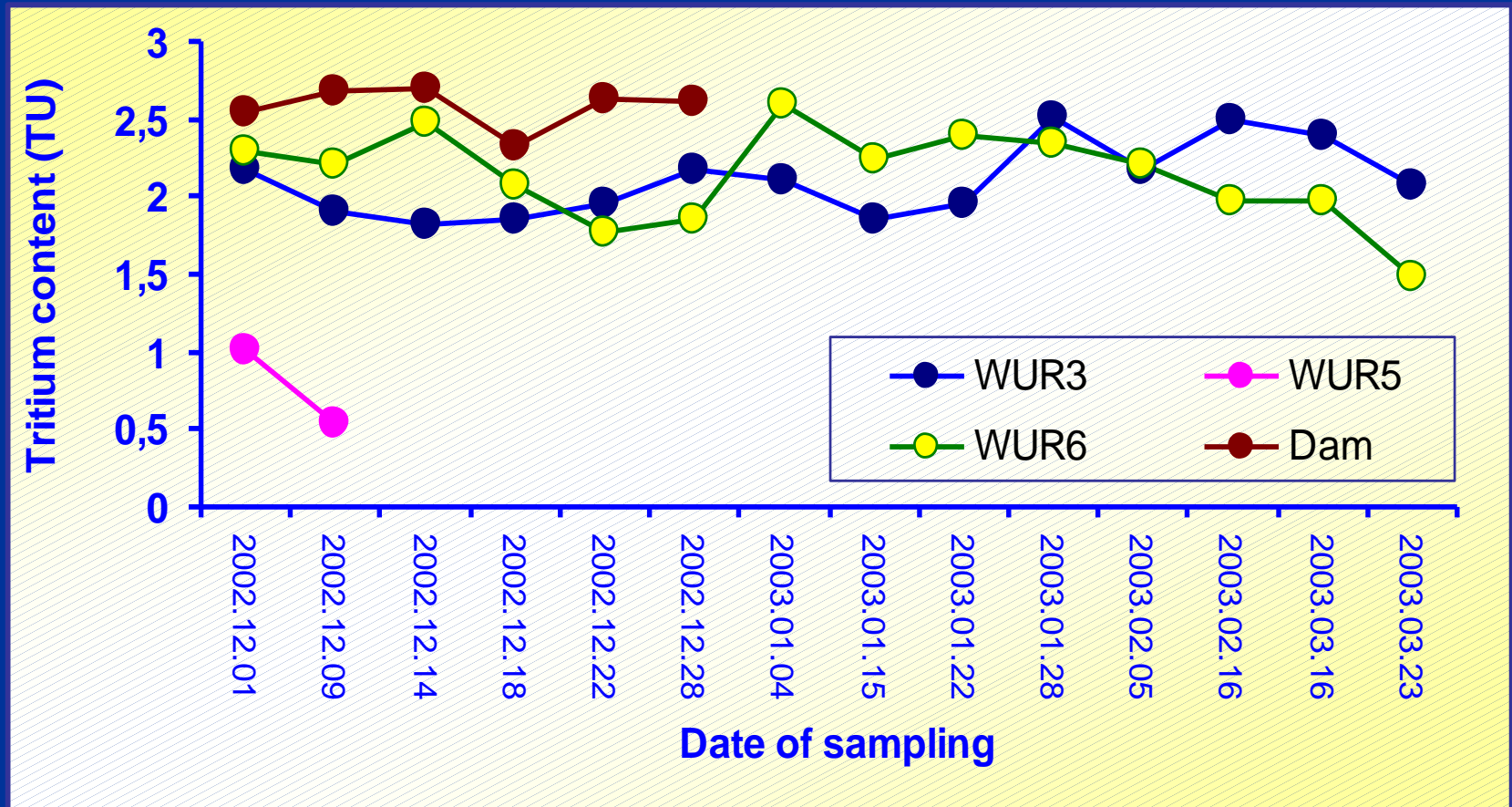




# Schoeller – Berkaloff Diagram (Wur Basin)



# Variation of 3H content in the Dam water and observation wells in Wurryah Basin

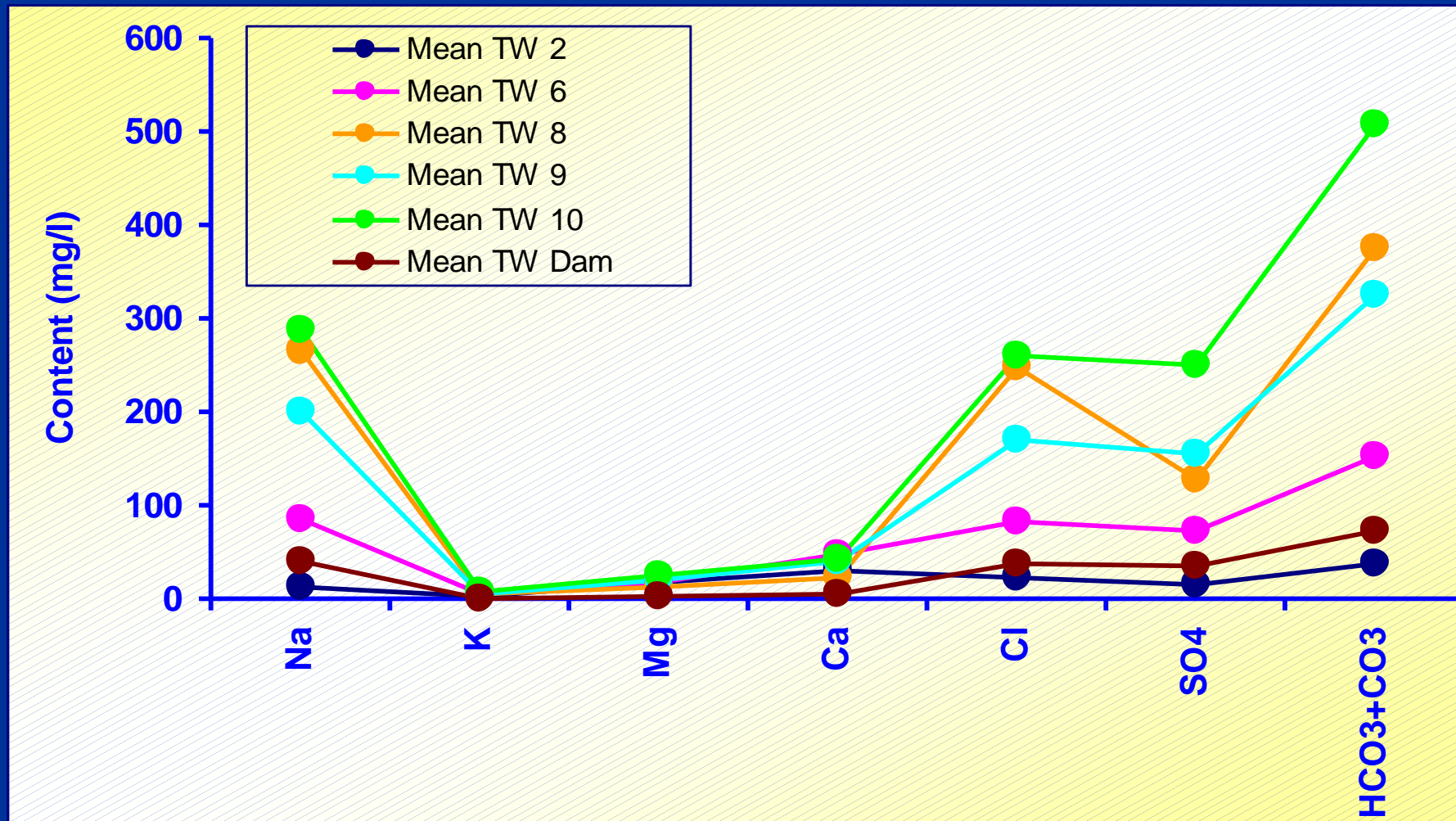


# Tawyeen Dam



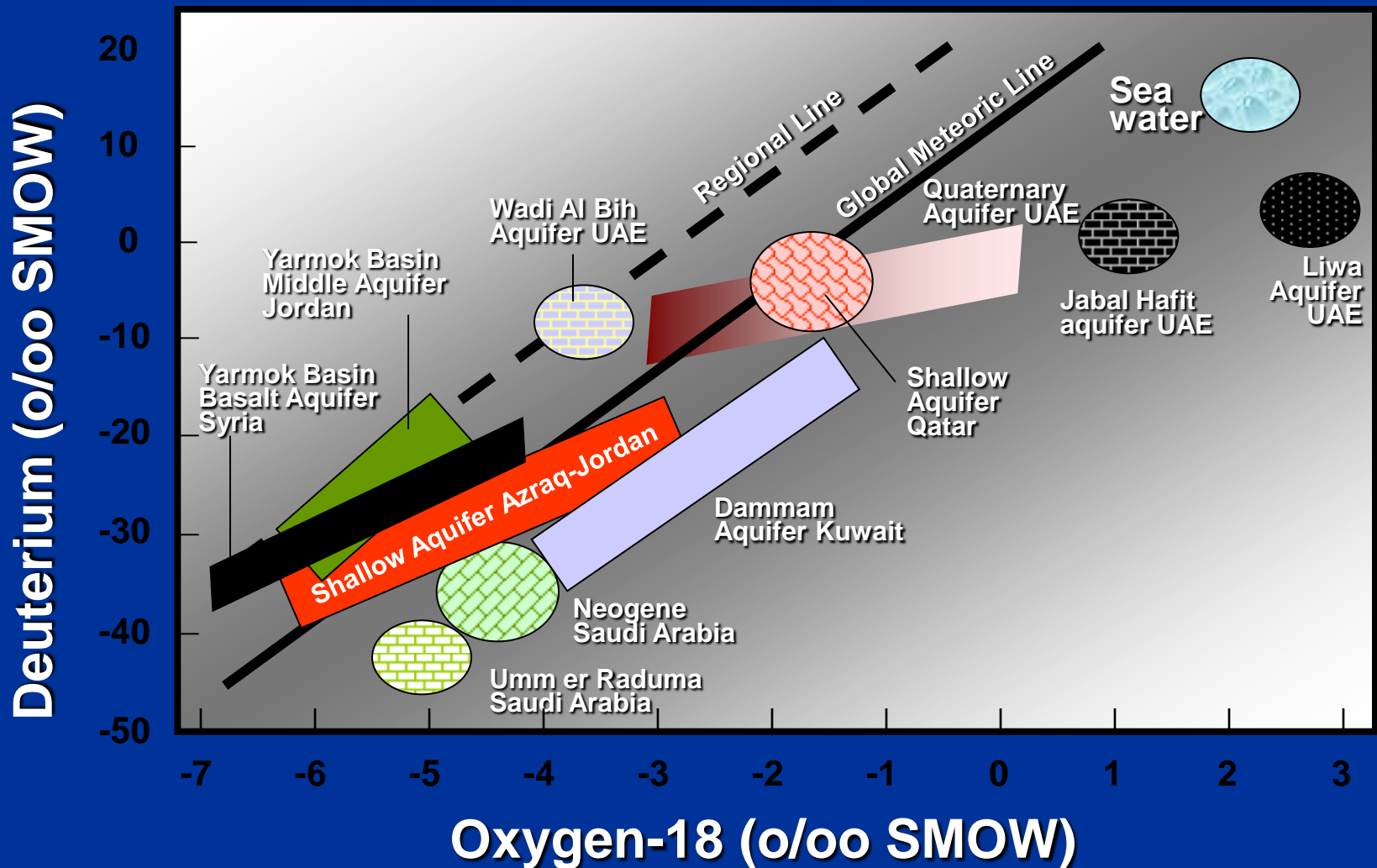
**Al Matri A. S. 2008**

# Schoeller-Berkaloff Diagram (Tw Basin )

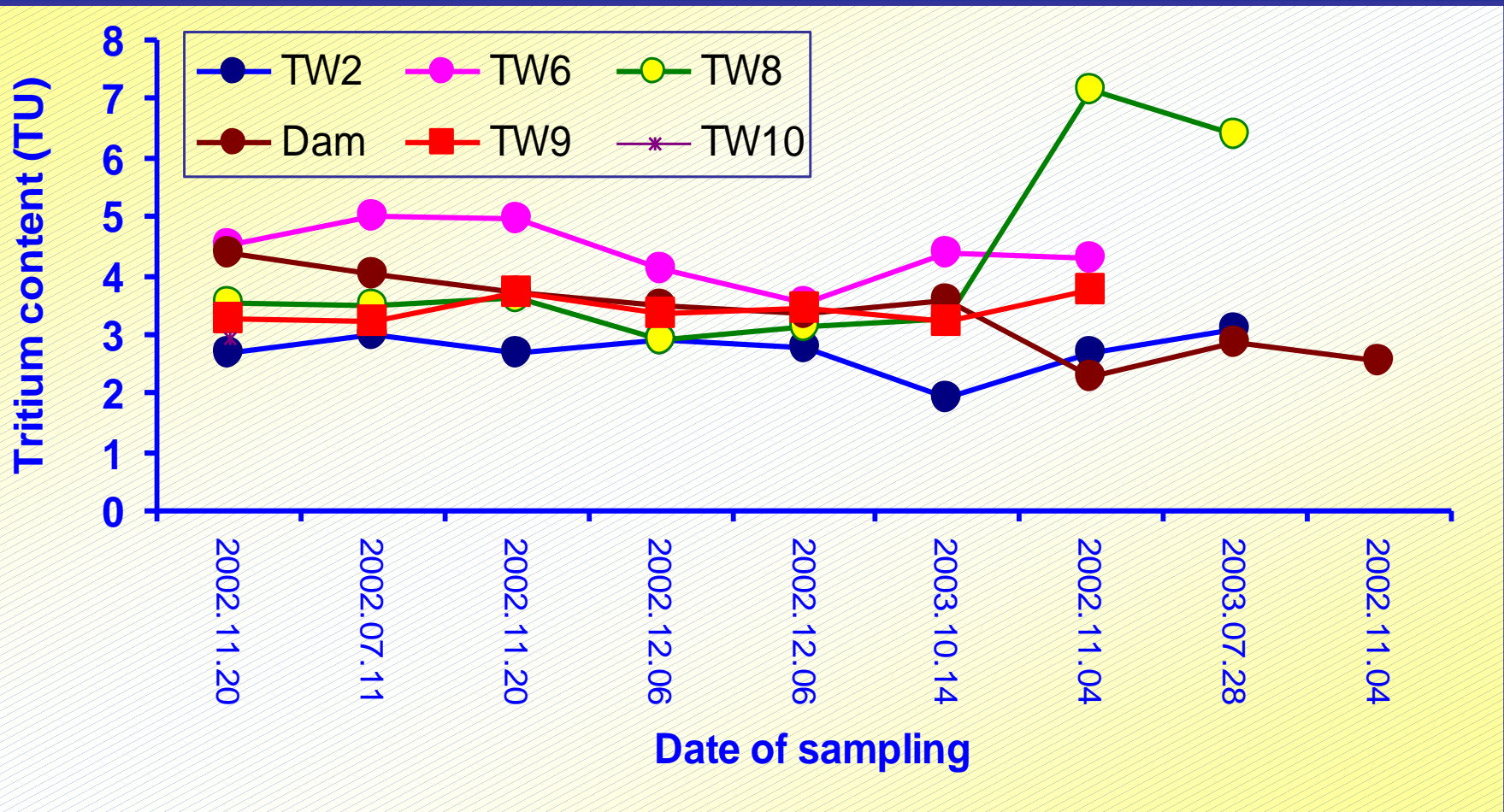




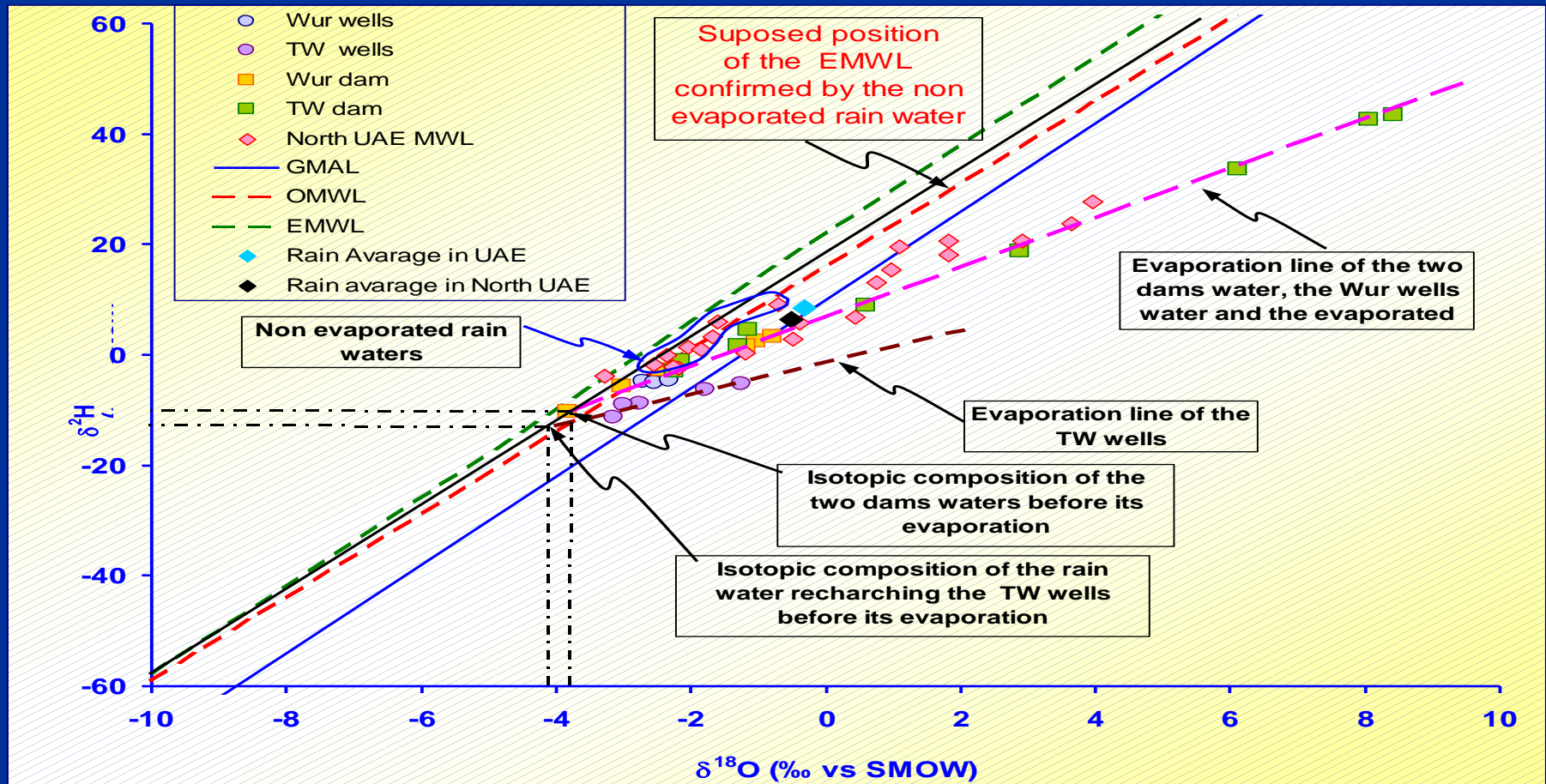
# Characteristic stable isotope concentrations of some major aquifer in the Gulf region and Middle East



# Variation of $^3\text{H}$ content in the Dam water and observation wells in Tawyeen basin



# $^{18}\text{O} / ^2\text{H}$ Diagram of Wurrayah , Tawyeen Dams and Observation Wells



## **Wur. Dam reservoir contribution estimated by the isotopic balance**

	<b>Average <math>^{18}\text{O}</math></b>	<b>Dam reservoir contribution ( % )</b>
<b>Wur - 2</b>	- 2.71	43.2
<b>Wur -5</b>	- 2.53	34.1
<b>Wur - 6</b>	- 2.32	22.9



## Discussion :

- ❖ Drawdown range between 4 – 10 m due to extensive use .
- ❖ Groundwater level increase due to the storage in the Dam reservoir 2 – 11 m .
- ❖ Isotope analysis show the a relatively similar variation in the concentration of major elements in both Dam and Observation wells.
- ❖ There is meaningful contribution to the recharge through the Wur. Dam in the wadi .

# Recommendations

**Considering the significant results obtained from Wurrayah Basin , it is highly recommended :**

- **Promote the isotopic methods in water management .**
- **Continue investigations for other Basins in the UAE with contribution and support of IAEA .**
- **Encourage the use of isotopic tracers for various investigations .**

A tropical sunset scene with palm trees and mountains. The sky is a mix of deep blue, purple, and orange. In the foreground, there are silhouettes of palm trees and a range of mountains. The text "Thank You" is written in a 3D, orange-yellow font with a black outline, positioned in the center of the image.

**Thank You**