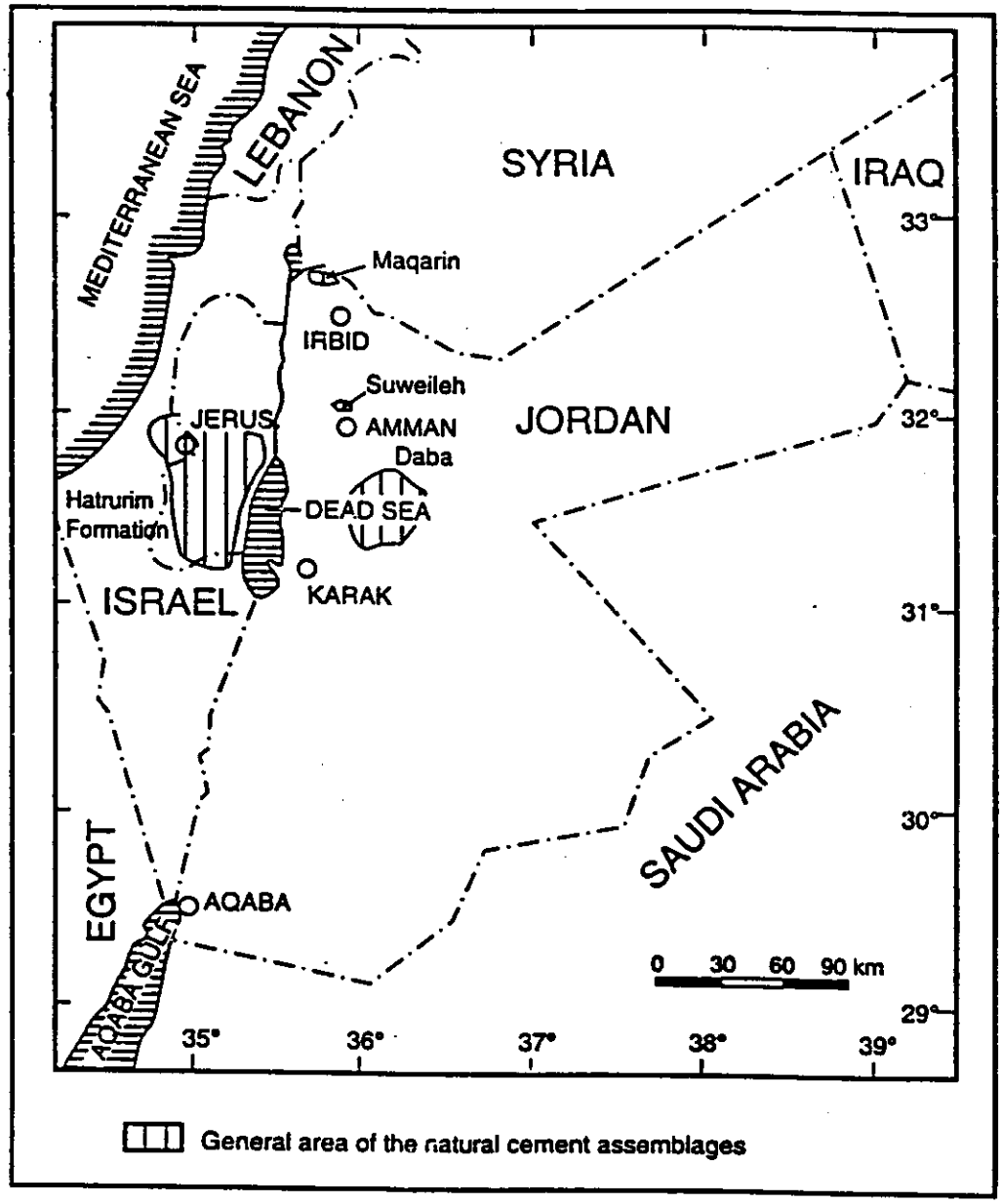
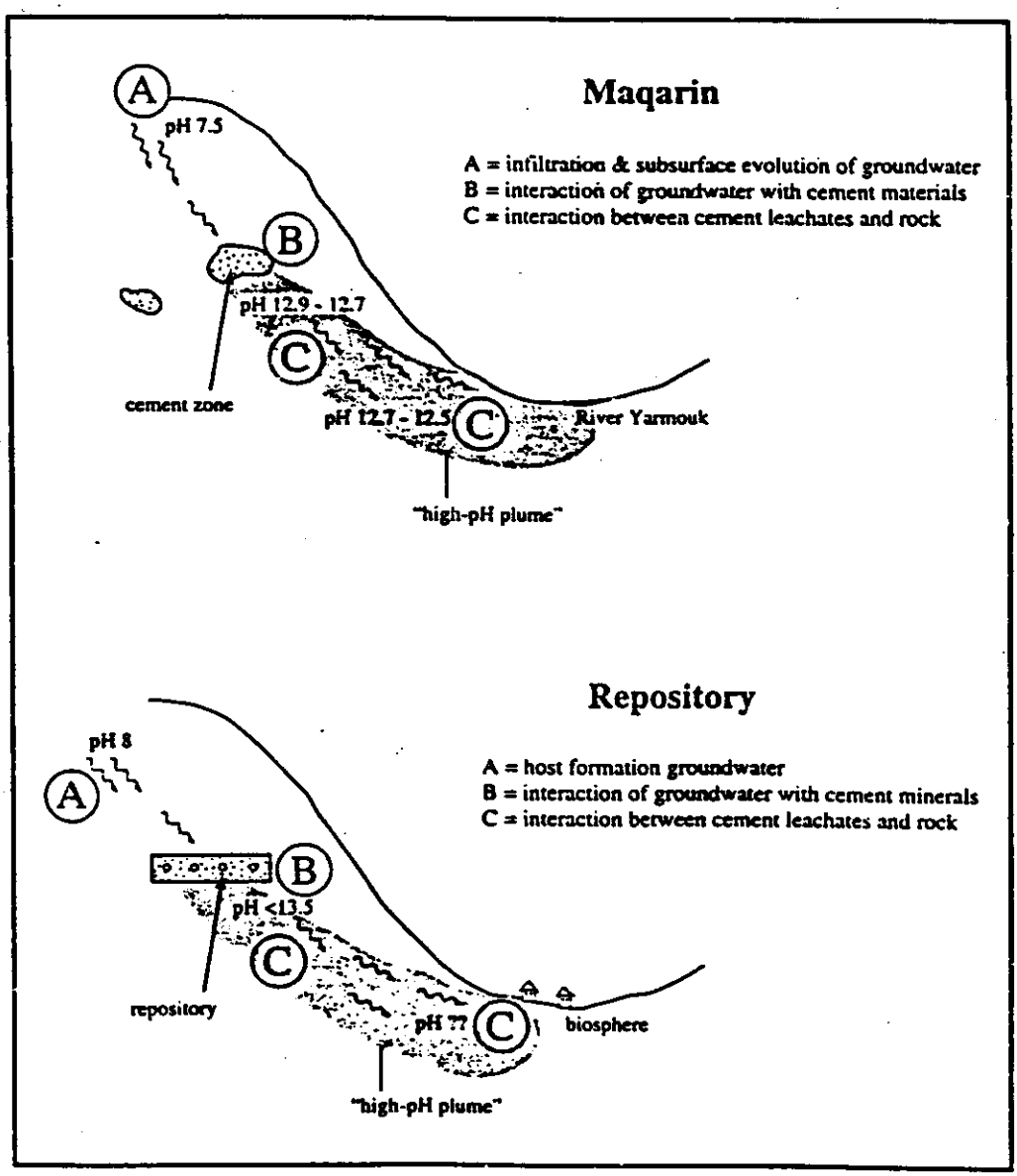
# CONCRETE & GROUNDWATER

## ALKALINE WATERS IN JORDAN


MEDITERRANEAN SEA
LEBANON
SYRIA
IRAQ
Maqarin
IRBID
Suweileh
AMMAN
JORDAN
JERUS
Daba
DEAD SEA
Hatrurim
Formation
KARAK
ISRAEL
SAUDI ARABIA
EGYPT
AQABA
ARABA GULF
0 30 60 90 km
33°
32°
31°
30°
29°
35°
36°
37°
38°
39°
General area of the natural cement assemblages


Maqarin
A = infiltration & subsurface evolution of groundwater
B = interaction of groundwater with cement materials
C = interaction between cement leachates and rock
A
pH 7.5
B
pH 12.9 - 12.7
C
cement zone
pH 12.7 - 12.5
C
River Yarmouk
"high-pH plume"
Repository
A = host formation groundwater
B = interaction of groundwater with cement minerals
C = interaction between cement leachates and rock
pH 8
A
B
pH <13.5
C
repository
pH ??
C
biosphere
"high-pH plume"

An example of the results of the radionuclide speciation and solubility test: predicted versus observed molar concentrations in the Jebel Awq spring, Semail ophiolite, northern Oman.

| Element | Prediction | Observed | Comments |
|---|---|---|---|
| Selenium | $5 \times 10^{-3}$ | $< 3 \times 10^{-9}$ | conservative |
| Palladium | $10^{-10}$ | $6.6 \times 10^{-9}$ | acceptable |
| Tin | $10^{-19}$ | $< 2 \times 10^{-9}$ | nonconservative |
| Zirconium | $5 \times 10^{-4}$ | $< 1 \times 10^{-9}$ | conservative |
| Nickel | $6 \times 10^{-7}$ | $< 1 \times 10^{-8}$ | conservative |
| Thorium | $5 \times 10^{-10}$ | $< 2 \times 10^{-10}$ | acceptable |
| Uranium | $8 \times 10^{-4}$ | $4.2 \times 10^{-11}$ | conservative |