Stable Cl Isotopes

Can stable Cl isotopes be used as evidence of non-recharge through desert basins?

Fractionation of $^{37}Cl/^{35}Cl$

-not expected under downward soil-water fluxes

-expected when diffusion is the main mechanism of solute transport (WHY? - the lighter isotope will be diffused more readily)

Is this fractionation effect measurable in arid and semiarid vadose zone profiles that contain typical shallow Cl- bulges?

Stable Cl Isotope Modeling

Initial conditions:

Uniform Cl- concentration

Uniform $\delta^{37}Cl = 0$ per mil

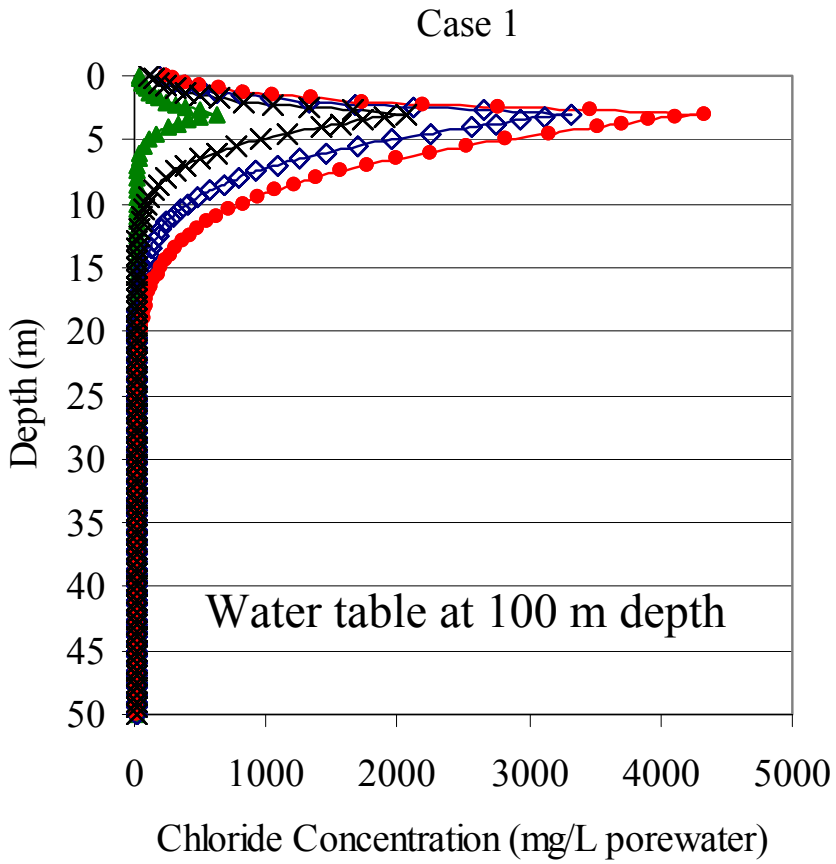
Boundary conditions:

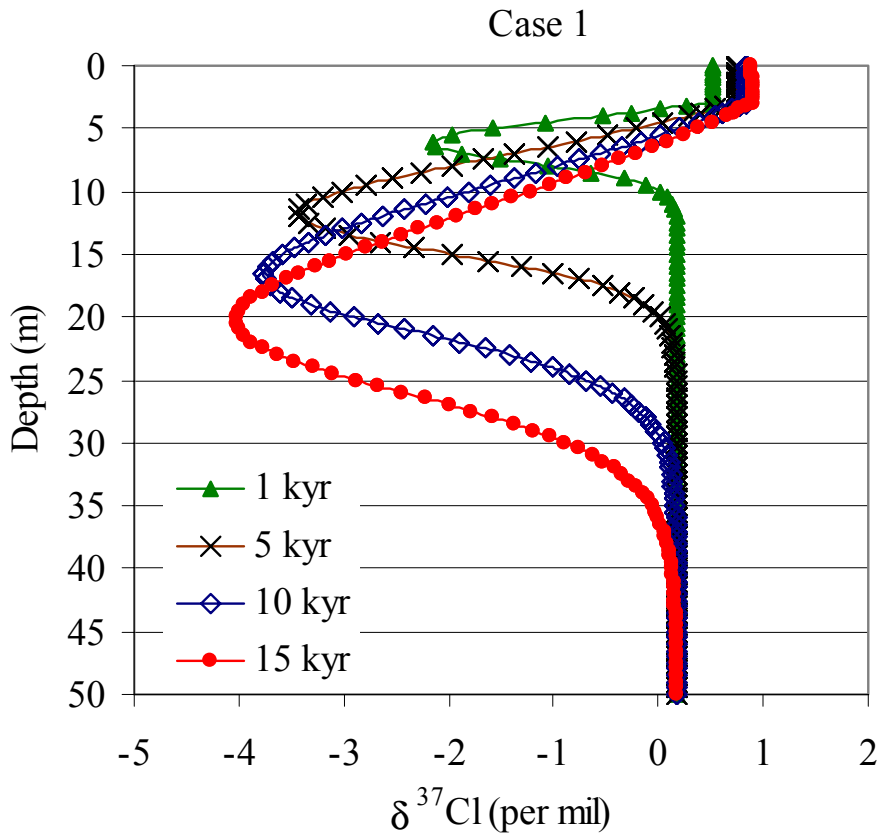
TOP - constant Cl^- deposition 100 $mg/m^2/yr$ at $\delta^{37}Cl = 0$ per mil (75% ^{35}Cl, 25% ^{37}Cl)

Base of the root zone sink for H_2O only

Water table at 100 m depth, $\delta^{37}Cl = 0$ per mil

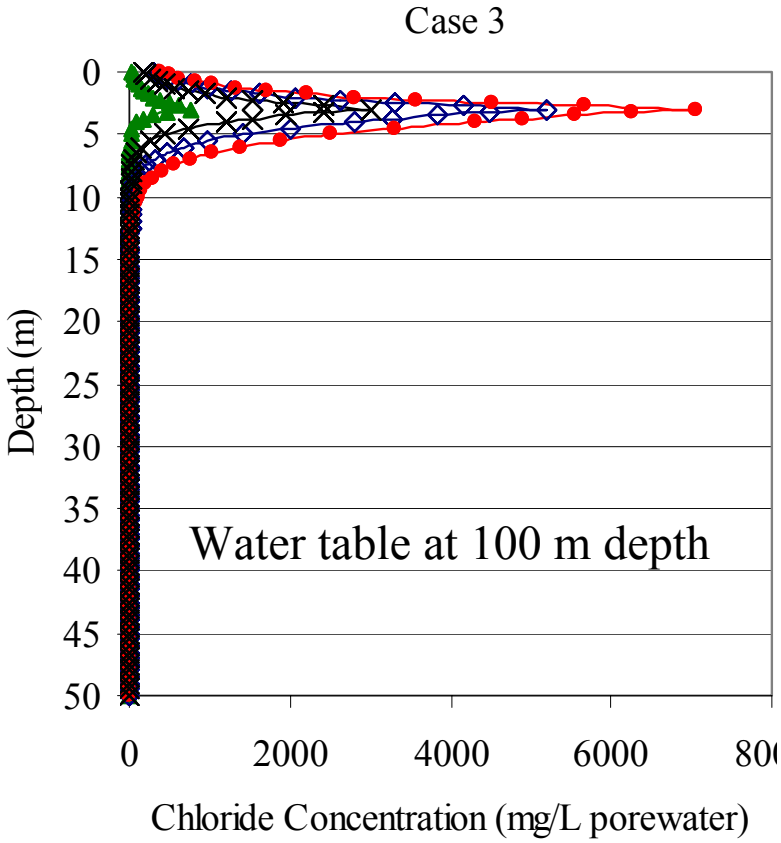
Stable Cl Isotope Modeling

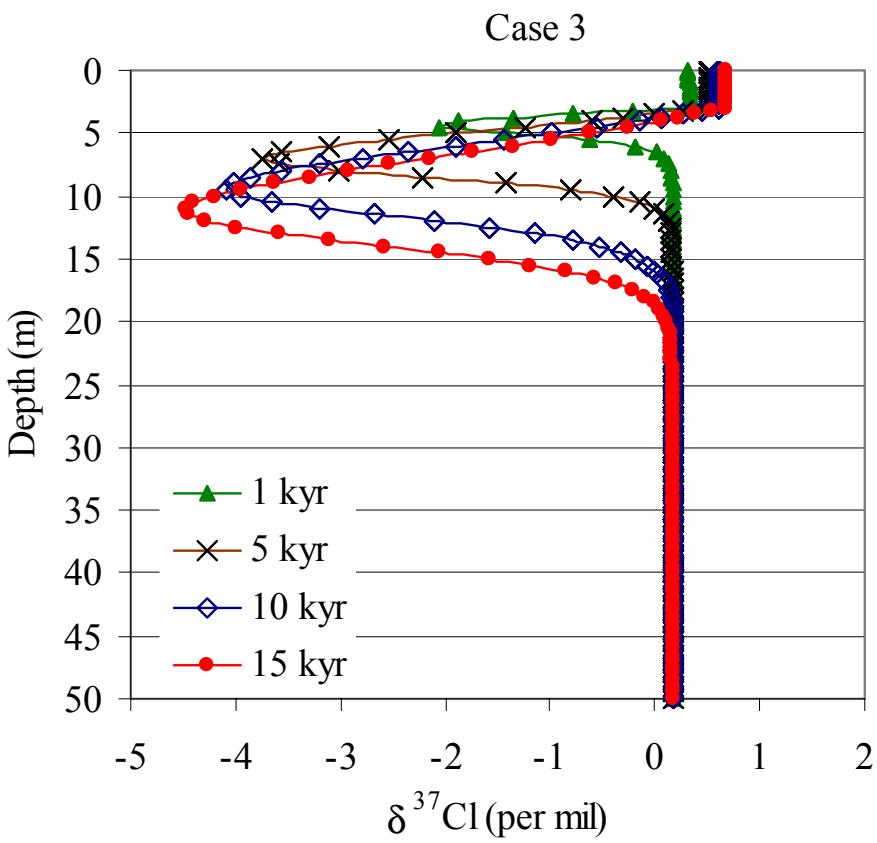




Molecular Diffusion Coefficient: for ^{37}Cl = 4.989 e-12 m^2/s
for ^{35}Cl = 5.000 e-12 m^2/s

Stable Cl Isotope Modeling





Molecular Diffusion Coefficient: for ^{37}Cl = 9.978 e-12 m^2/s
for ^{35}Cl = 1.000 e-12 m^2/s

Predicted δ^{37}Cl Behavior in the VZ

1) depletion in δ^{37}Cl below the shallow chloride bulge resulting from the greater solute diffusion rate of the lighter isotope.

2) downward migration of the maxima in the δ^{37}Cl depletion with time

3) deeper location of the maxima in the δ^{37}Cl depletion associated with higher molecular diffusion coefficients