$Cu[I]Cl_2^-$	0	0 0	-1	1 0 0	0	0 0	2	-0.25	-13.949
$Cu[I]Cl_3^{-2}$	0	0 0	-1	1 0 0	0	0 0	3	-0.25	-13.141
$Cu[IIO_2^{-2}$	0	0 0	-4	1 0 0	0	0 0	0	0	-39.45

Table 6.11. Total Concentration of Components Initially in the Matrix Fluid and in the Injection Fluid.

Component	Initial Concentration (mol/dm^3 liquid)	Injection Fluid Concentration (mol/dm^3 liquid)
Na^+	5.00250E-3	5.2600E-3
K^+	2.57809E-5	1.3305E-4
Ca^{2+}	6.86031E-4	1.6086E-2
H^+	1.54064E-5	3.4649E-1
Cu^{2+}	3.23586E-8	1.0520E-8
Al^{3+}	2.04237E-8	2.6300E-2
Fe^{2+}	3.59984E-12	4.5694E-2
$SiO_{2\,(aq)}$	1.87124E-4	2.0243E-3
HCO_3^-	1.74271E-3	3.5737E-4
SO_4^{2-}	5.00246E-4	2.7435E-1
Cl^-	3.67274E-3	5.2600E-3
$O_{2\,(aq)}$	2.52896E-4	1.1689E-2
pH	8.0	1.0

The injection fluid has a pH of 1.0 and density of 1.0520 kg/dm^3. Its composition remains constant throughout the simulation. The total concentration of the aqueous components in the injection fluid is detailed in Table 6.11. The dissolution of the copper ore is pH dependent; as can be seen from reaction **(6.7.1)**, the dissolution rate is proportional to the activity of H^+ to the 0.39 power.

The simulation was run for a period of 0.25 years using a uniform time step of 1E-3 years. The same time step is used for both hydrologic transport and for the geochemical reactions. The operator splitting solution method was implemented. Figure 6.5 depicts the projected copper recovery and the pH and pe at the extraction well over time. Figures 6.6 and 6.7 show the spatial distribution of chrysocolla and the five secondary minerals at the end of the 0.25 year simulation. The results compare well with those provided by Lichtner (1997). The input data sets for this example are given in Table 6.12.