WTNP113 - Resaturation of an cell

Summary:

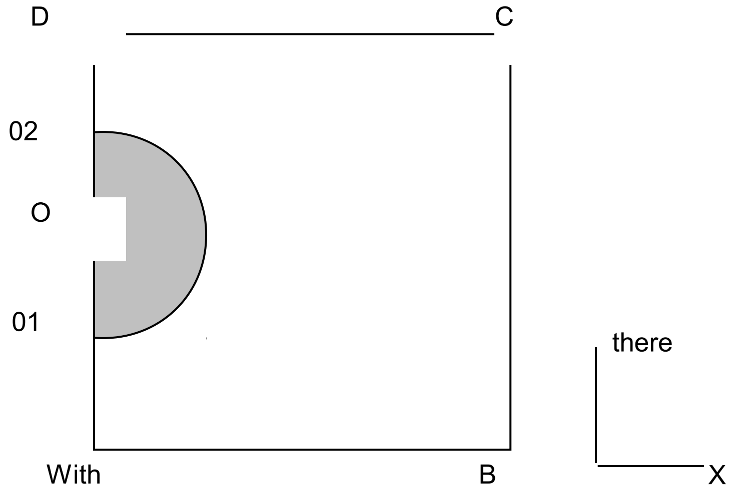
The test presented here makes it possible to check the good performance of the operators used for the resolution of the equations of a flow in unsaturated medium. This test corresponds to test 3.2 of the plan of qualification of the project ALLIANCES [bib1].

It represents the evolution of water saturation of the medium around an cell of storage. Two phases are taken into account, a phase of desaturation at the time of the exploitation of the underground work and a phase of resaturation after the fill of gallery of the cells.

1 Problem of reference

1.1 Geometry

The studied field represents a cut of ground around an cell of storage.



Coordinates of the points (m) :

A	0	-500	C	10	-400
B	10	-500	D	0	-400
O	0	-450			

Ray of the cell: $5.6\,m$

Note:

The cell is not on the scale on the diagram.

1.2 Properties of material

One gives here only the properties on which the solution depends. The command file contains other data of material (temperatures,…) who do not play any part in the solution of with the dealt problem.

Liquid water	Density ($kg.m^{-3}$)	1000
	Viscosity	1
Homogenized parameters	Permeability K	$10^{-18}\,m^{-2}$
	Isotherm of sorption	$S(P_c)=0.15+\frac{0.85}{\left[1+(6.5.10^{8}\,P_c)^{1.49}\right]^{0.33}}$
	Relative permeability	$kr_w(P_c)=S^3$
		0.14

Porosity	$4.10^{-10} m^{-1}$
Storage	

1.3 Initial conditions

The problem comprises two phases:

- First a 15 years phase of desaturation corresponding to the exploitation of the underground work.
- One second phase of resaturation after the fill of the cell corresponding to the exploitation (one initializes the saturation of the cell with 0.7).

The initial conditions are the following ones:

For phase 1

- Cell $P_c=9{,}4.10^7 Pa$ ($S=0{,}49$)
- Geological barrier $P_c=1.10^5 Pa$ ($S=0{,}999$)

For phase 2 ($t>15\,ans$)

- Cell $P_c=3{,}015.10^7 Pa$ ($S=0{,}7$)

1.4 Boundary conditions

They are expressed on the capillary pressure.

Phase 1:

On $[AB]$ $P_c=1.10^5 Pa$
On $[CB]$ Hydraulic flow no one
On $[CD]$ $P_c=1.10^5 Pa$
On $[A01]\cup[02D]$ Hydraulic flow no one

On the whole of the cell $P_c=9{,}4.10^7 Pa$ ($S=0{,}49$).

Phase 2:

On $[AB]$ $P_c=1.10^5 Pa$
On $[CB]$ Hydraulic flow no one
On $[CD]$ $P_c=1.10^5 Pa$
On $[AD]$ Hydraulic flow no one

2 Reference solution.

One is based on the results of the plan of qualification of the project ALLIANCES [bib1].
Tests of nonregression are also carried out.

2.1 Bibliographical references

1) Project Alliances plan of qualification, note ANDRA CNT-ASCS 02-075B

3 Modeling A

3.1 Characteristics of modeling A

The results presented here result from modeling in plane deformations D_PLAN_THHD carried out with 2988 elements TRI3.

3.2 Results

One presents the profiles of capillary pressure and saturation on a horizontal cut ($y=450\mathrm{m}$) and verticals ($x=7\mathrm{m}$).

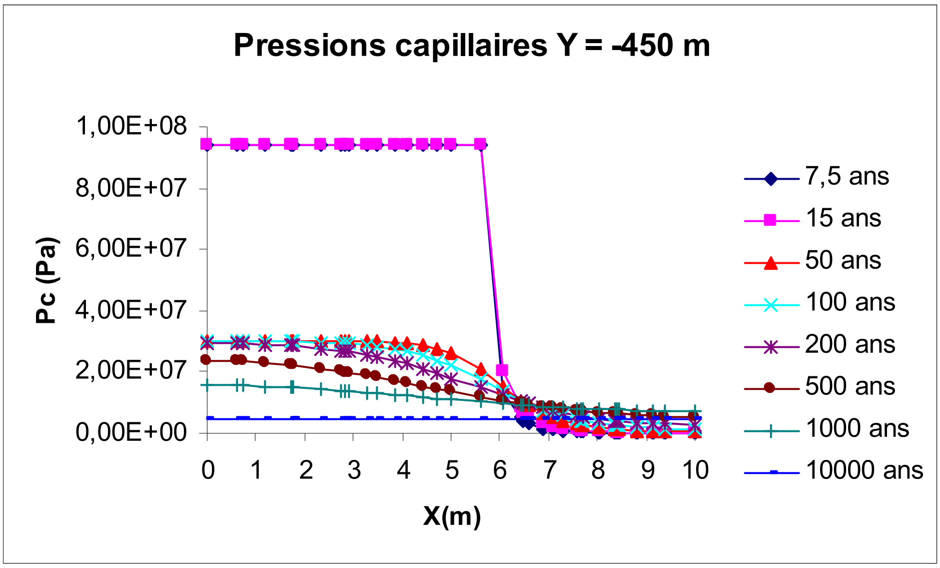


Figure 3.3-a: Profiles of capillary pressure $Y=-450\text{m}$

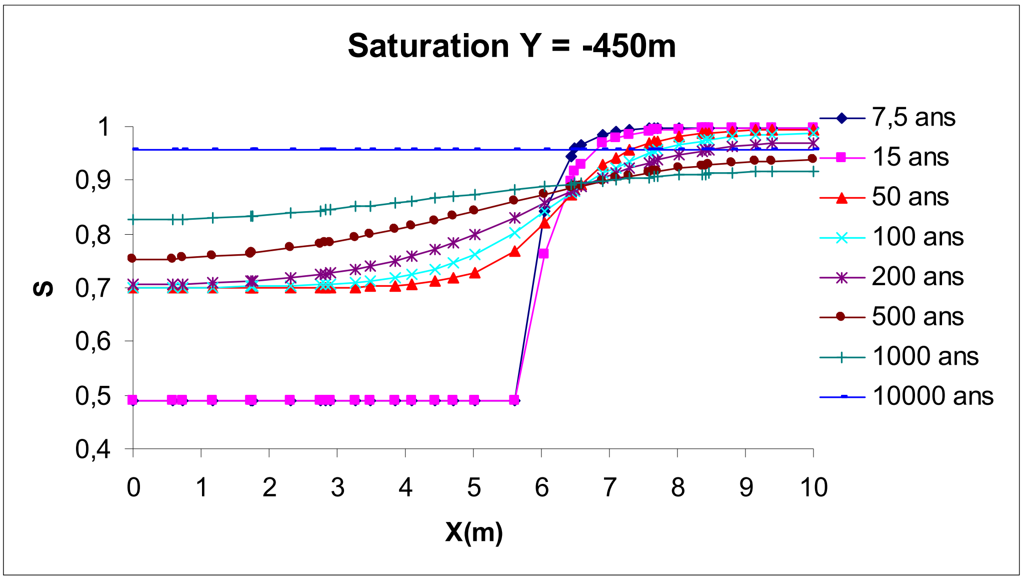


Figure 3.3-b: Profiles of saturation $Y=-450\text{m}$

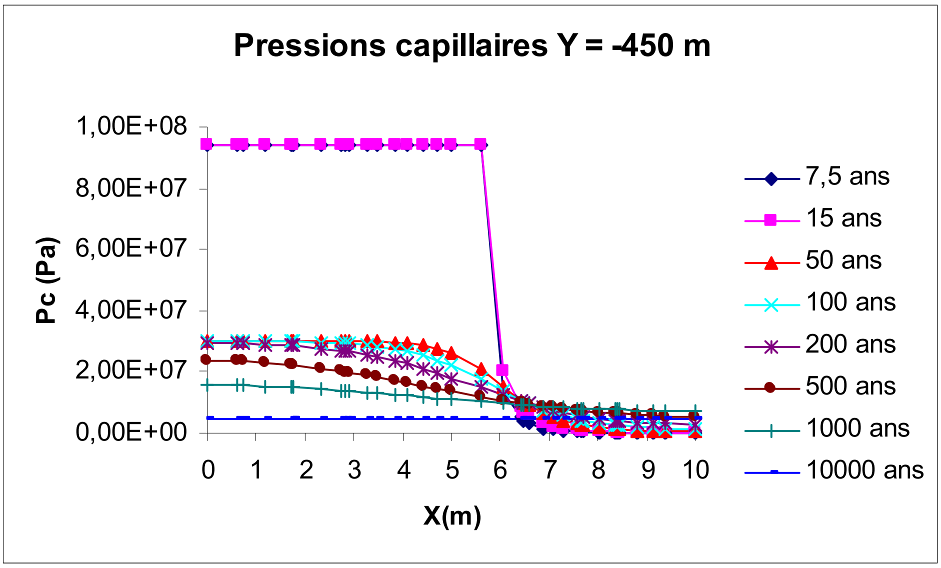


Figure 3.3-c: Profiles of capillary pressure $X=7m$

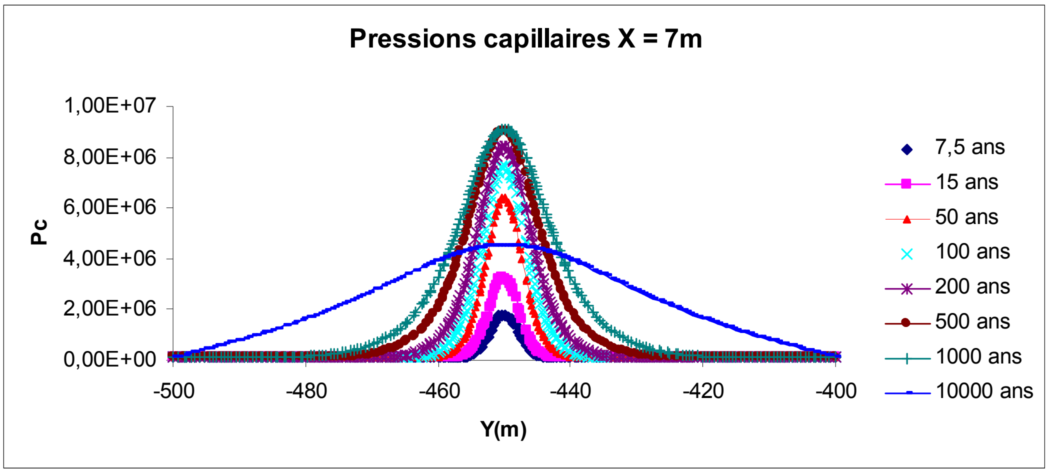


Figure 3.3-d: Profiles of saturation $X=7m$

3.3 Sizes tested and results

X (m)	Y (m)	Time (years)	$PRE1$ (Pa) External source	Tolerance ($\%$)
5	-450	27	2.9E7	20
5	-450	10000	4.35E6	20
7	-450	27	3.6E6	20
7	-450	10000	4.34E6	20

The results are qualitatively in conformity with those which one finds in the literature of Alliances: one has only isovaleurs in reference, also the tolerance of error is rather tall (20%).

4 Modeling B

4.1 Characteristics of modeling B

It acts of the same modeling as above but with miscible modeling THH2D (with a coefficient of infinite Henry). The expected results must thus be exactly the same ones.

4.2 Sizes tested and results

X (m)	Y (m)	Time (years)	$PRE1$ (Pa) External source	Tolerance ($\%$)
5	-450	27	2.9E7	20
5	-450	10000	4.35E6	20
7	-450	27	3.6E6	20
7	-450	10000	4.34E6	20

The results are qualitatively in conformity with those which one finds in the literature of Alliances: one has only isovaleurs in reference, also the tolerance of error is rather tall (20%).

5 Modeling C

5.1 Characteristics of modeling C

Even modeling that the A but into selective.

5.2 Sizes tested and results

X (m)	Y (m)	Time (years)	$PRE1$ (Pa) External source	Tolerance ($\%$)
5	-450	27	2.9E7	20
5	-450	10000	4.35E6	20
7	-450	27	3.6E6	20
7	-450	10000	4.34E6	20

The results are qualitatively in conformity with those which one finds in the literature of Alliances: one has only isovaleurs in reference, also the tolerance of error is rather tall (20%).

6 Modeling D

6.1 Characteristics of modeling D

Even modeling that B but into selective.

6.2 Sizes tested and results

X (m)	Y (m)	Time (years)	$PRE1$ (Pa) External source	Tolerance ($\%$)
5	-450	27	2.9E7	20
5	-450	10000	4.35E6	20
7	-450	27	3.6E6	20
7	-450	10000	4.34E6	20

The results are qualitatively in conformity with those which one finds in the literature of Alliances: one has only isovaleurs in reference, also the tolerance of error is rather tall (20%).

7 Summary of the Results

Generally, results got with *Code_Aster* are qualitatively in conformity with those which one finds in the literature of ALLIANCES.