

## WTNP113 - Resaturation of a Summarized

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### cell:

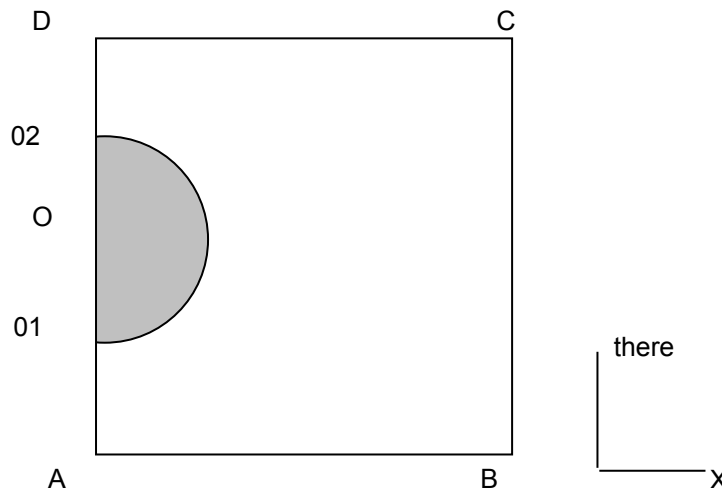
The test presented here makes it possible to check the good performance of the operators used for the resolution of the equations of a flow in unsaturated medium. This test corresponds to test 3.2 of the plane of qualification of the project ALLIANCES [bib1].

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 operating 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.



Coordinated points ( m ):

|          |    |      |          |    |      |
|----------|----|------|----------|----|------|
| <i>A</i> | 0  | -500 | <i>C</i> | 10 | -400 |
| <i>B</i> | 10 | -500 | <i>D</i> | 0  | -400 |
| <i>O</i> | 0  | -450 |          |    |      |

Radius of the cell: 5.6 m

**Note:**

| The cell is not on the scale on the diagram.

### 1.2 Properties of the 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<br>Parameters | Permeability $K$        | $10^{-18} m^{-2}$   |
|                           | Isothermal sorption     | $S(P_c) = 0.15 + \frac{0.85}{[1 + (6.5 \cdot 10^8 P_c)^{1.49}]^{0.33}}$ |
|                           | relative Permeability   | $kr_w(P_c) = S^3$<br>0,14   |

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

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## 1.3 Initial conditions

the problem comprises two phases:

- First a 15 years phase of desaturation corresponding to the operating of the underground work.
- One second phase of resaturation after the fill of the cell corresponding to the operating (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 Flux no one
- On  $[CD]$   $P_c = 1.10^5 Pa$
- On  $[A0I] \cup [02D]$  hydraulic Flux no one

On the group 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 Flux no one
- On  $[CD]$   $P_c = 1.10^5 Pa$
- On  $[AD]$  hydraulic Flux no

## 2 Reference solution.

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One leans on the results of the plane of qualification of the project ALLIANCES [bib1].  
One also carries out tests of non regression.

### 2.1 Bibliographical references

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

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Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

## 3 Modelization A

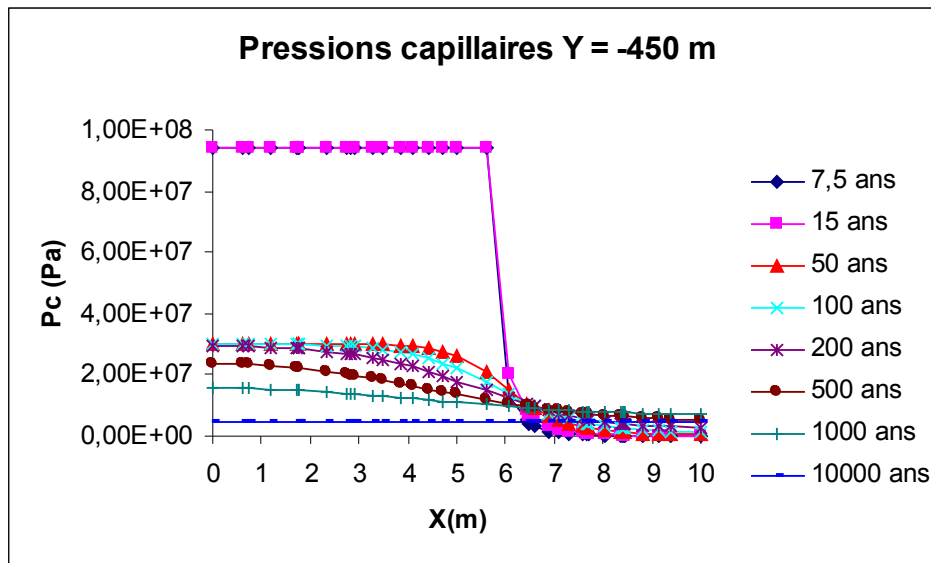
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### 3.1 Characteristic of the modelization A

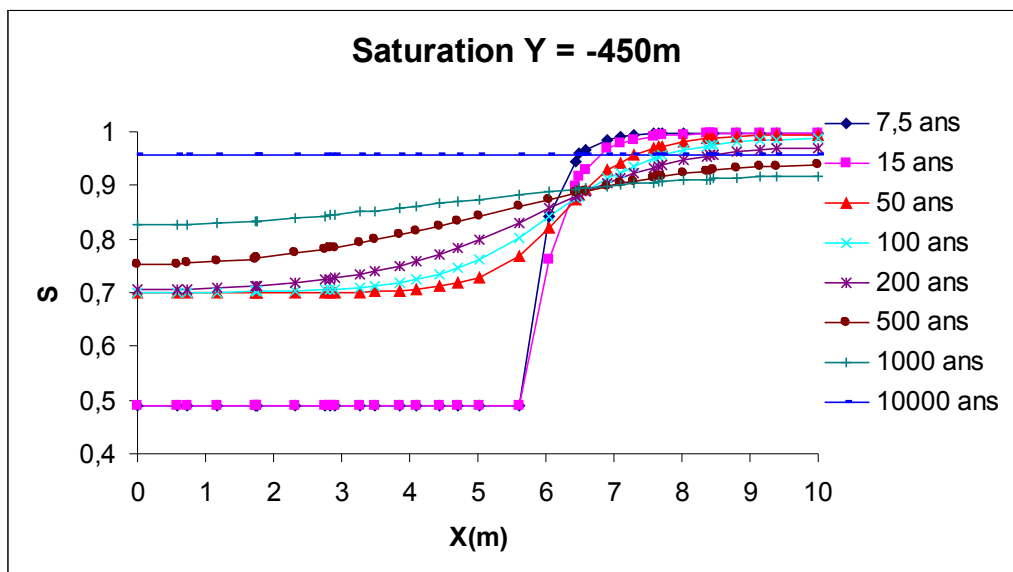
the results presented here result from the modelization in plane strains carried out with 2988 elements TRI3.

### 3.2 Results

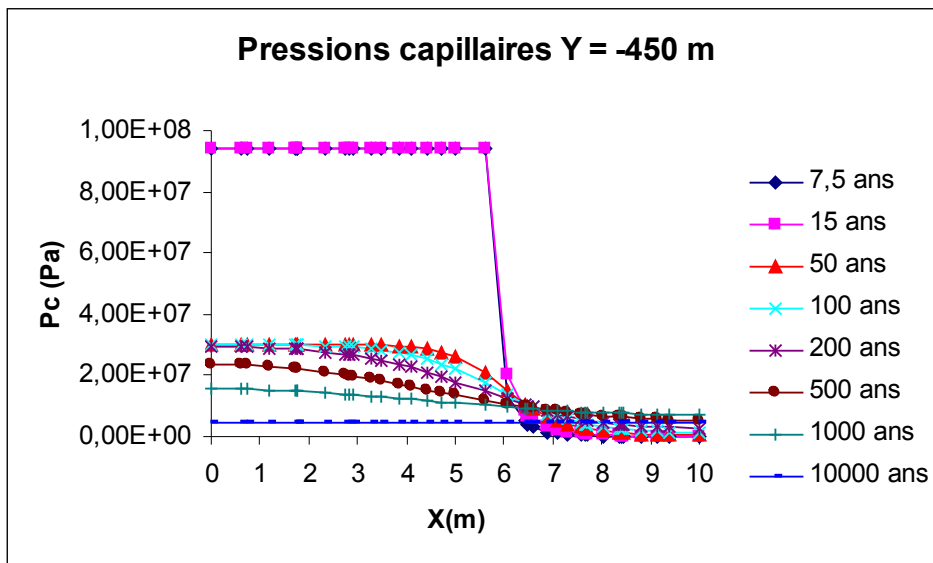
One presents the profiles of capillary pressure and saturation on a horizontal cut (  $y=450\text{m}$  ) and verticals (  $x=7\text{m}$  ).



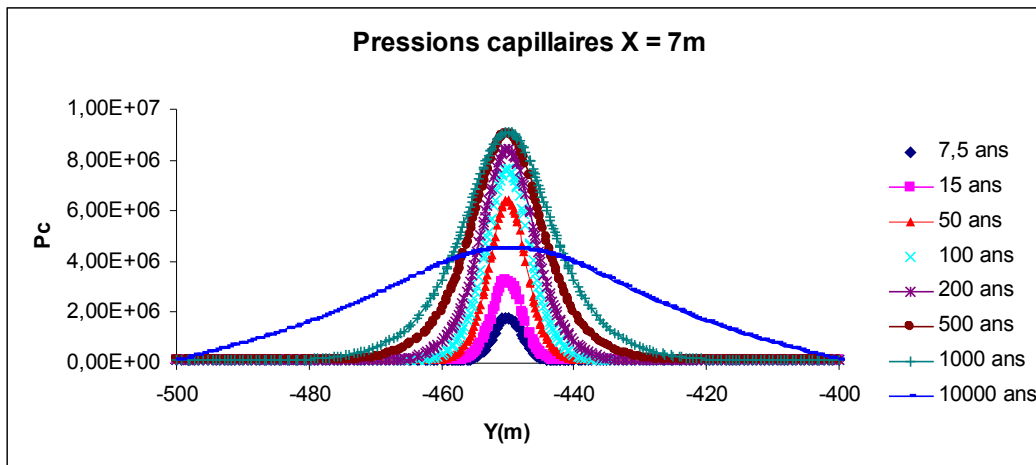
Appear 3.3-a: Profiles of capillary pressure  $Y = -450m$



Appears 3.3-b: Profiles of saturation  $Y = -450m$



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



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

### 3.3 Quantities tested and results

| $X (m)$ | $Y (m)$ | Time (years) | $PREI (Pa)$<br>Aster | $PREI (Pa)$<br>Aster | Difference (%) |
|---------|---------|--------------|----------------------|----------------------|----------------|
| 5       | -450    |              | 27.2.9E7             | 2.9E7                | 0.037          |
| 5       | -450    | 10000        | 4.35E6               | 4.35E6               | 0.108          |
| 7       | -450    |              | 27.3.6E6             | 3.6E6                | 0.736          |
| 7       | -450    | 10000        | 4.34E6               | 4.34E6               | 0.012          |

These 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% ).

One adds a case of non regression:

| $X (m)$ | $Y (m)$ | Time (years) | $PREI (Pa)$<br>Aster |
|---------|---------|--------------|----------------------|
| 7       | -450    | 10000        | 4.34E6               |

## 4 Modelization B

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### 4.1 Characteristic of the modelization B

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

### 4.2 Quantities tested and results

| $X (m)$ | $Y (m)$ | Time (years) | $PREI (Pa)$<br>Aster | $PREI (Pa)$<br>Aster | Difference (%) |
|---------|---------|--------------|----------------------|----------------------|----------------|
| 5       | -450    |              | 27.2.9E7             | 2.9E7                | 0.037          |
| 5       | -450    | 10000        | 4.35E6               | 4.35E6               | 0.108          |
| 7       | -450    |              | 27.3.6E6             | 3.6E6                | 0.736          |
| 7       | -450    | 10000        | 4.34E6               | 4.34E6               | 0.012          |

These 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% ).

One adds a case of non regression:

| $X (m)$ | $Y (m)$ | Time (years) | $PREI (Pa)$<br>Aster |
|---------|---------|--------------|----------------------|
| 7       | -450    | 10000        | 4.34E6               |



## 5 Modelization C

### 5.1 Characteristic of the modelization C

Even modelization that A but into selective.

### 5.2 Quantities tested and results

| $X (m)$ | $Y (m)$ | Time (years) | $PREI (Pa)$<br>Aster | $PREI (Pa)$<br>Aster | Difference (%) |
|---------|---------|--------------|----------------------|----------------------|----------------|
| 5       | -450    |              | 27.2.9E7             | 2.87E7               | 1              |
| 5       | -450    | 10000        | 4.35E6               | 4.20E6               | 3.3            |
| 7       | -450    |              | 27.3.6E6             | 3.02E6               | 16             |
| 7       | -450    | 10000        | 4.34E6               | 4.20E6               | 3.2            |

These 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% ).

One adds a case of non regression:

| $X (m)$ | $Y (m)$ | Time (years) | $PREI (Pa)$<br>Aster |
|---------|---------|--------------|----------------------|
| 7       | -450    | 27           | 3.0158E6             |

## 6 Modelization D

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### 6.1 Characteristic of the modelization D

Even modelization that B but into selective.

### 6.2 Quantities tested and results

| $X (m)$ | $Y (m)$ | Time (years) | $PRE1 (Pa)$<br>Aster | $PRE1 (Pa)$<br>Aster | Difference (%) |
|---------|---------|--------------|----------------------|----------------------|----------------|
| 5       | -450    |              | 27.2.9E7             | 2.87E7               | 1              |
| 5       | -450    | 10000        | 4.35E6               | 4.20E6               | 3.3            |
| 7       | -450    |              | 27.3.6E6             | 3.02E6               | 16             |
| 7       | -450    | 10000        | 4.34E6               | 4.20E6               | 3.2            |

These 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% ).

One adds a case of non regression:

| $X (m)$ | $Y (m)$ | Time (years) | $PRE1 (Pa)$ Aster |
|---------|---------|--------------|-------------------|
| 7       | -450    | 27           | 4.20E6            |

## 7 Summary of the Results

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