KivSimEiBase vs. KivSimEi[*] (free beta version)

* The enhanced import/export functionalities of KivSimEi are developed in the framework of the GEOTREF research project (www.geotref.org). They are freely available through a beta version of KivSimEi, which is a temporary plugin. Eventually, they will be moved into a new plugin GefSim, which will provide a comprehensive link between SKUA-GOCAD and geothermal simulators.
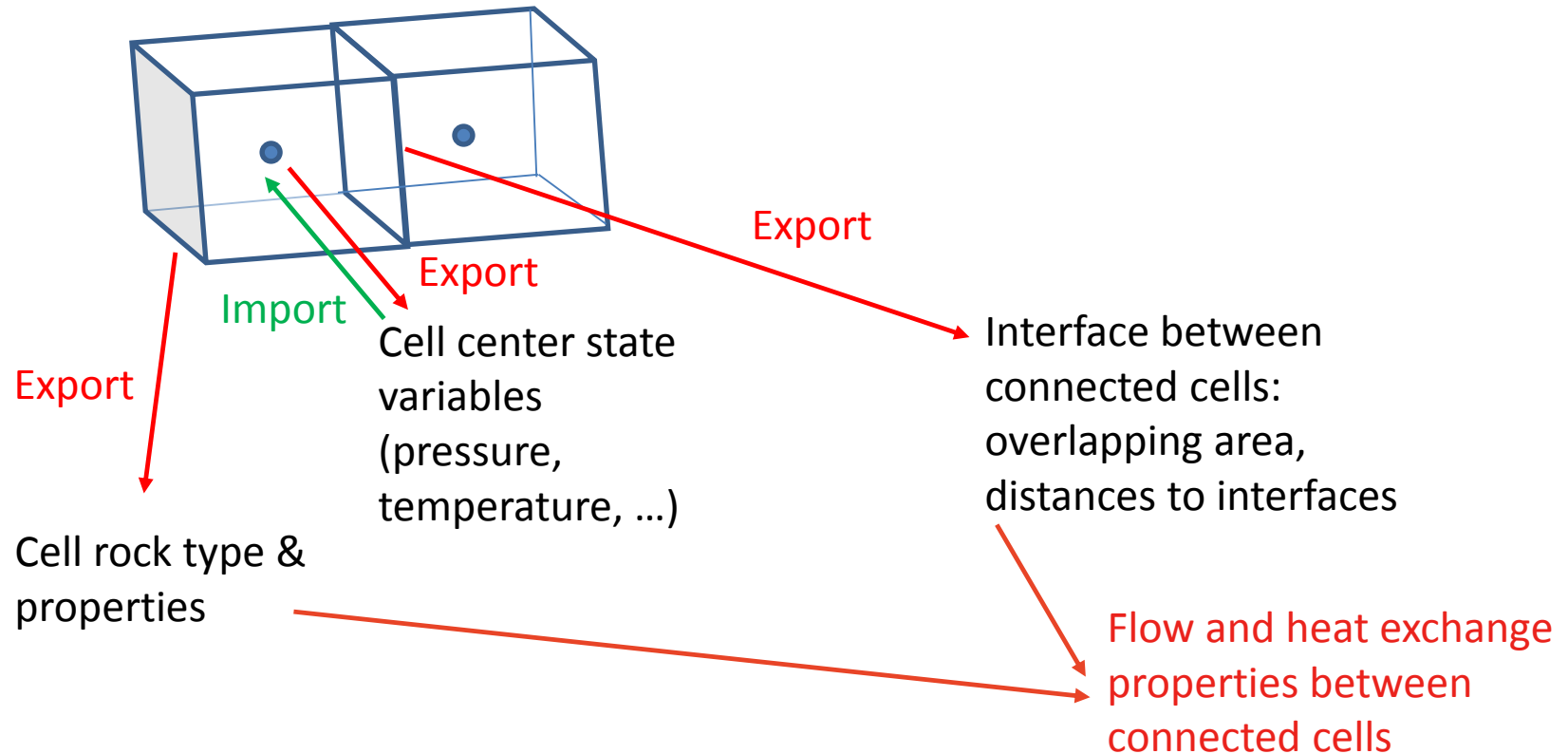
Export and import capabilities
for the TOUGH2 suite of simulators

KIDOVA

Knowledgeable & Imaginative Visions

TOUGH2 EXPORT CAPABILITIES

1. Possible import and export of grid data
2. Export of grid data (ROCKS & MESH files)
3. Conductive discontinuities modifiers
4. Non-conductive discontinuities modifiers
5. State variable data (INCON file)
6. Well data (GENER file)

Possible import and export of grid data

Export

Export

Import

Export

Cell center state variables (pressure, temperature, …)

Interface between connected cells: overlapping area, distances to interfaces

Cell rock type & properties

Flow and heat exchange properties between connected cells

Export of grid data

Basic grid data to export

- Rocks model complexity
- Block data (volume, permeability factor)

New in KivSimEi: export of top and bottom boundary condition (BC) cells

- Possibility to add top and bottom cells (not present in the reservoir grid known by SKUA-GOCAD), and to specify their connections with top and bottom reservoir grid cells, in order to define top and bottom Dirichlet boundary conditions (BC) in TOUGH2 (prescribed state variable values)

Export of top and bottom BC cells

- **New in KivSimEi**
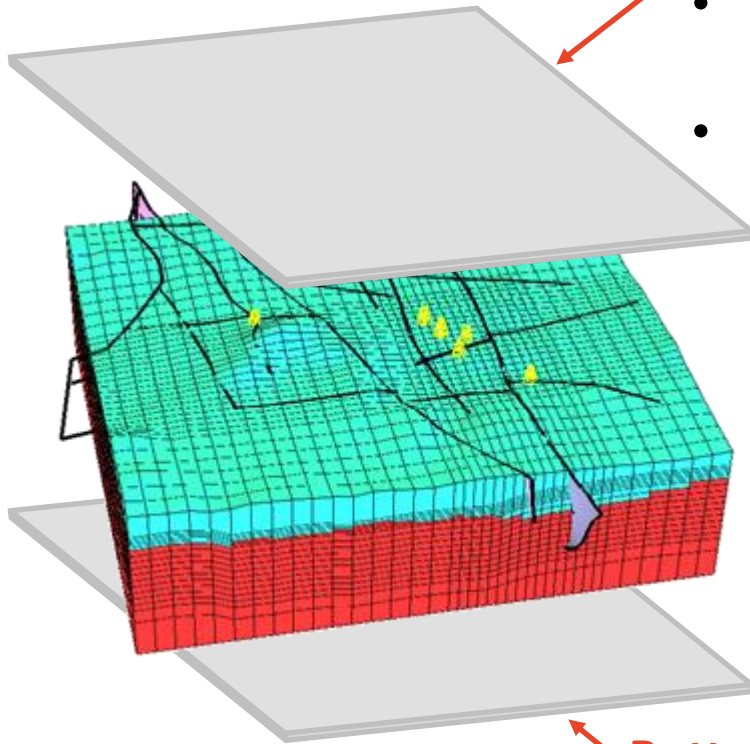
Top boundary condition cell known by TOUGH2
- Usually thin (small distance from the reservoir grid) but with a high volume
- Connected to all or part of top reservoir grid cells

Grid known by SKUA-GOCAD

Bottom boundary condition cell known by TOUGH2
- Usually thin (small distance from the reservoir grid) but with a high volume
- Connected to all or part of bottom reservoir grid cells

Taking into account discontinuities

- **New in KivSimEi**
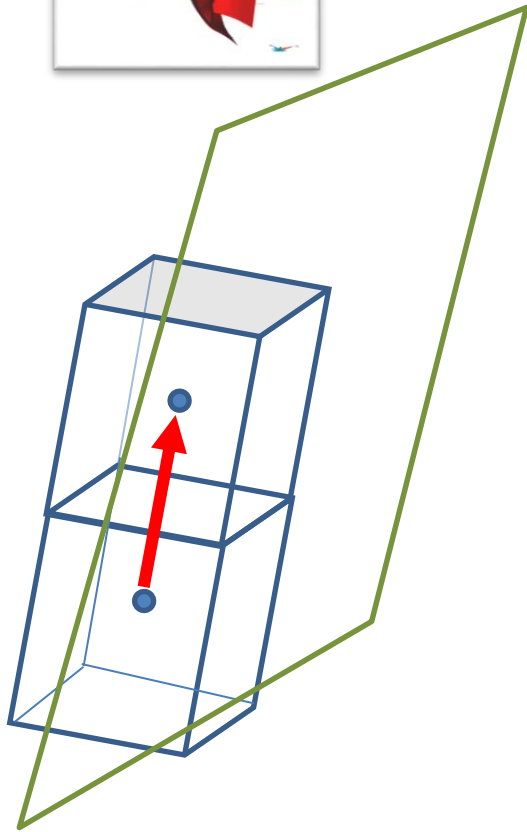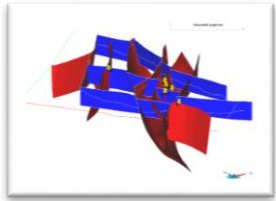
Conductive discontinuity
=> **increased transmissibility through increased area**
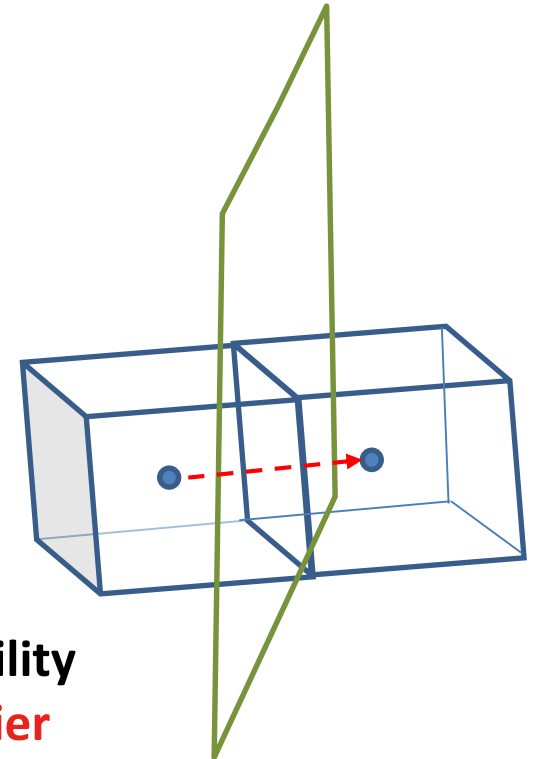
Sealed discontinuity
=> **decreased transmissibility**
Not a heat transport barrier

Adding intermediate cells known only by TOUGH2
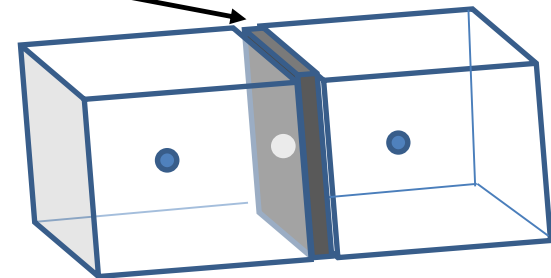
Taking into account discontinuities

- ## Nonconductive discontinuities

New in KivSimEi: non-conductive discontinuities

- Accounting for nonconductive discontinuities by adding intermediate cells, known only by TOUGH2, in between GOCAD-SKUA grid cells.

- New cell properties are calculated from GOCAD-SKUA grid cell properties, based on a permeability (reduction) factor and a volume (reduction) factor.

Taking into account discontinuities

- Conductive discontinuities
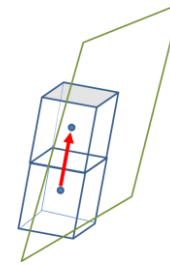
New in KivSimEi: conductive discontinuity modifiers

- Accounting for conductive discontinuities by correcting the transmissibility of connected cells for which the interface is intersected by one or several discontinuity surfaces.

- The correction applies to the interface area (only interface parameter available as input to TOUGH2) and is based on the intersection length and the transmissivity assigned to each discontinuity.

- Exporting conductive discontinuities into a dual permeability model is an option which is not yet available (interest to be confirmed).

State variable data (INCON file)

New in KivSimEi: boundary conditions

- Specifying the state variable values in the top and bottom boundary condition cells
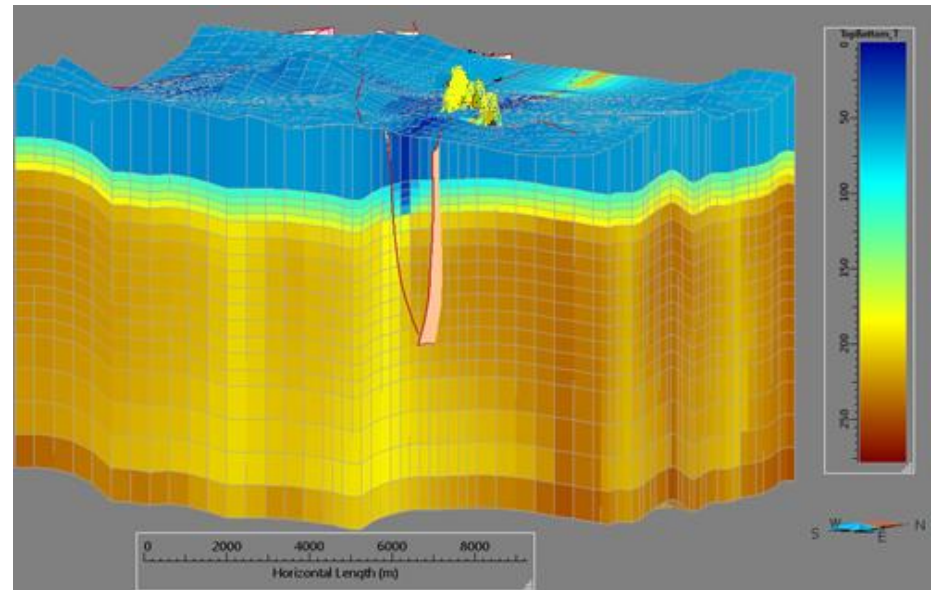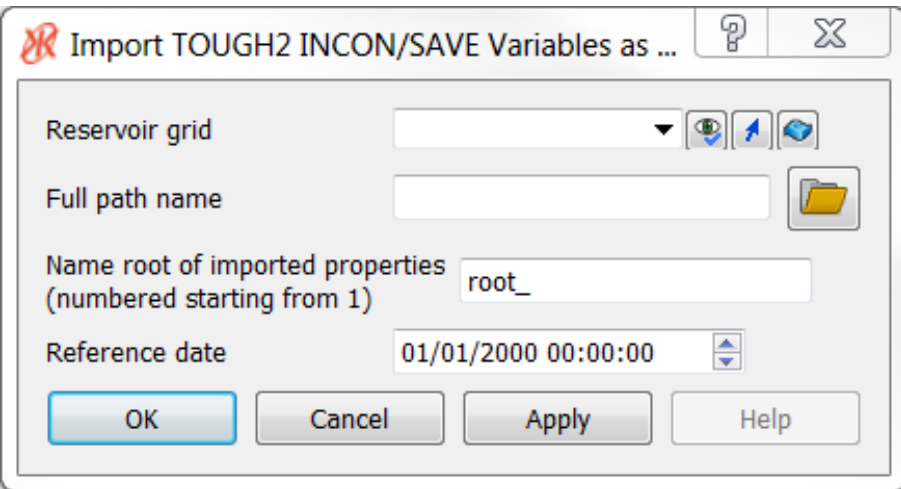
Well data (GENER file)

TOUGH2 IMPORT CAPABILITIES

1. Final simulated state variables (INCON/SAVE files)
2. Simulated state and derived variables at intermediate time-steps (*.out files)

   - Cell centered variables
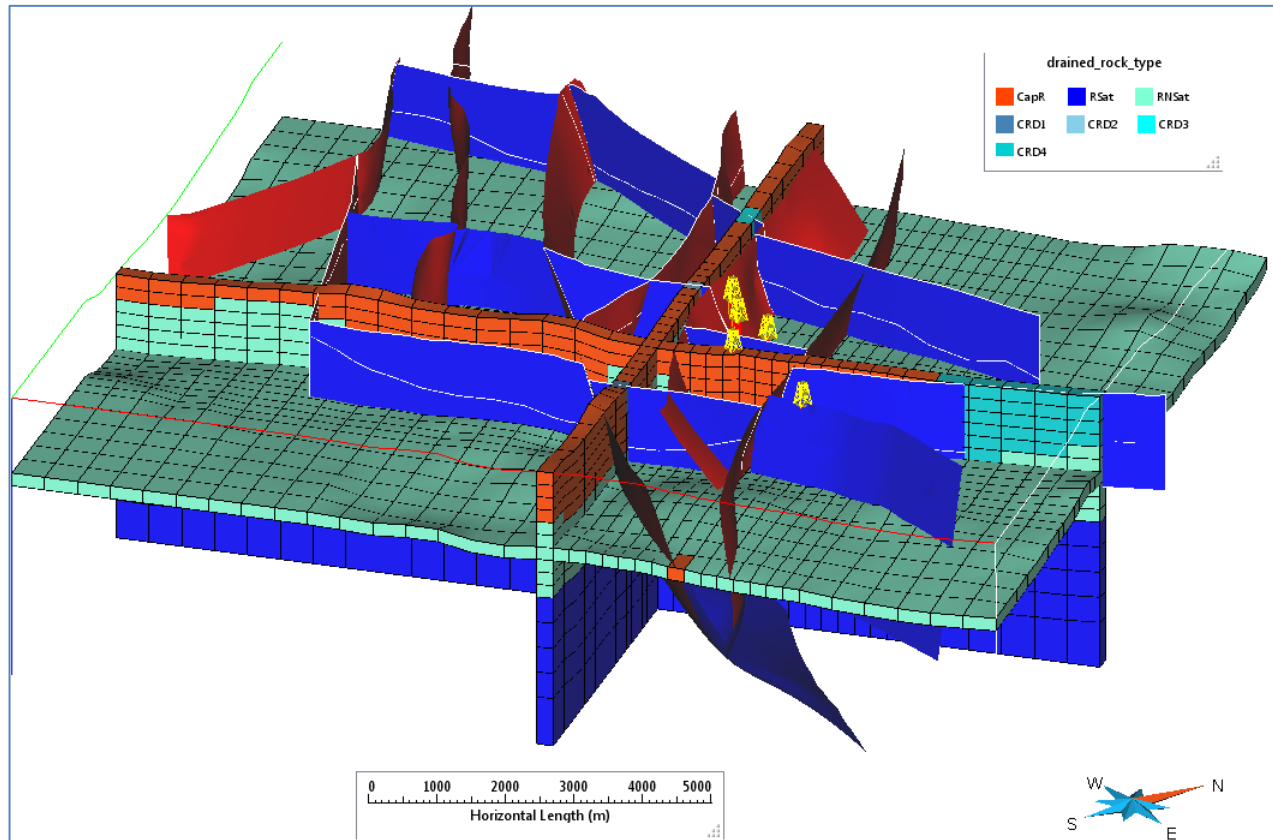   - Cell exchange variables
   - Flux vectors

INCON/SAVE files

*.out files
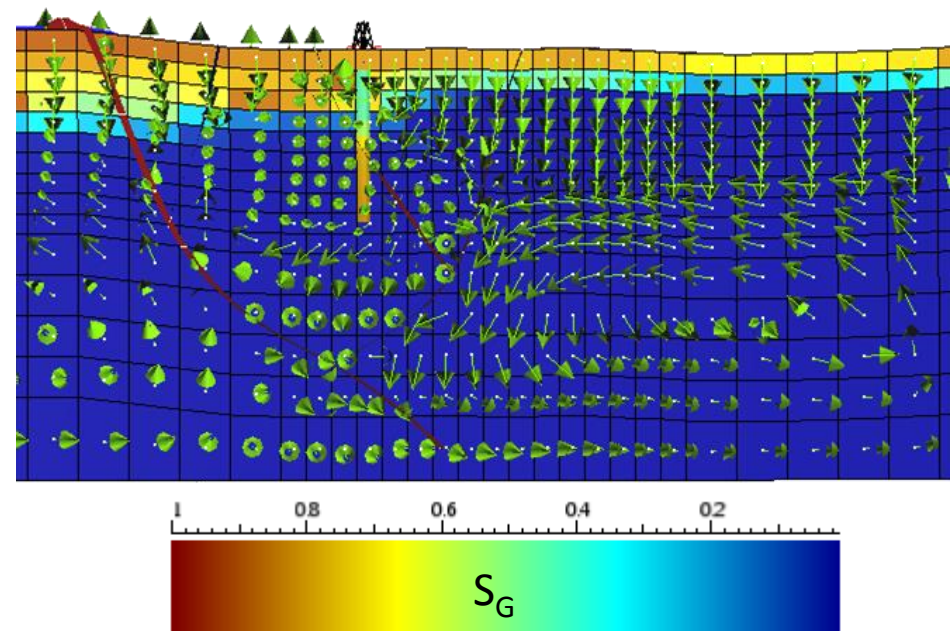
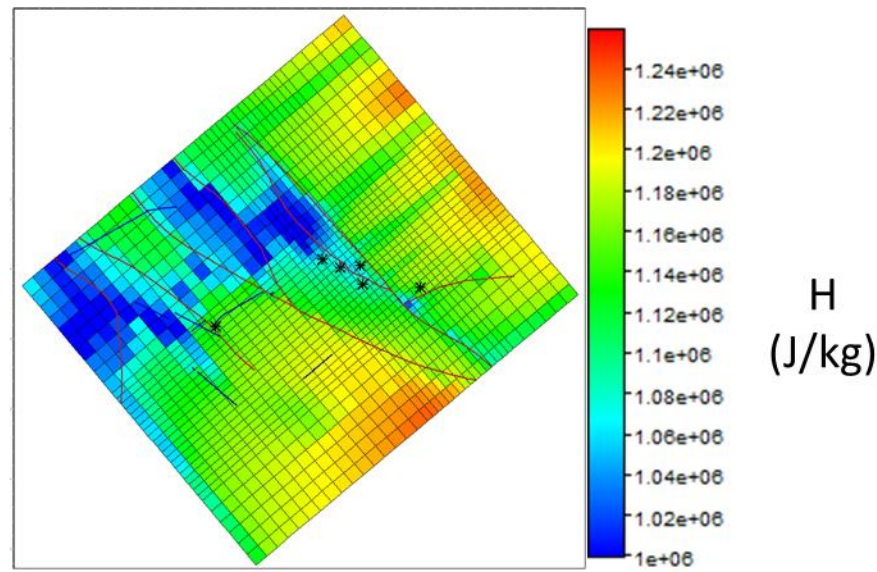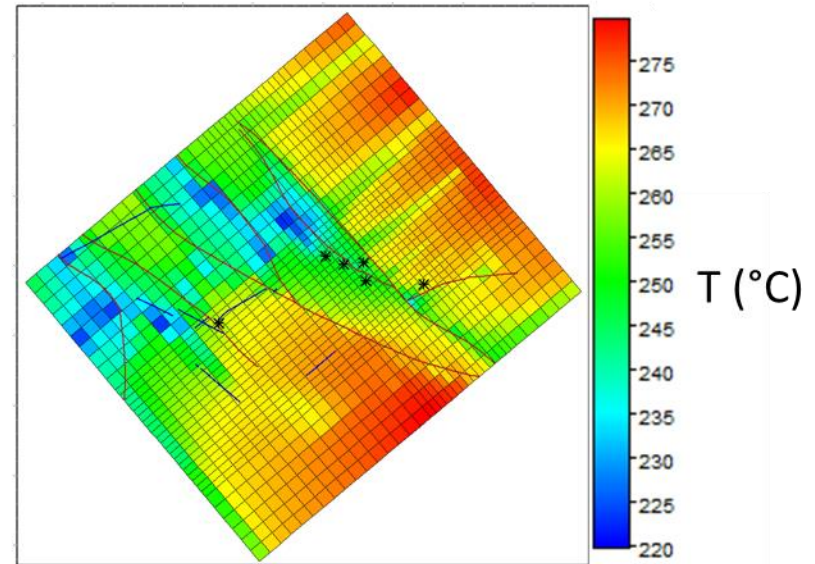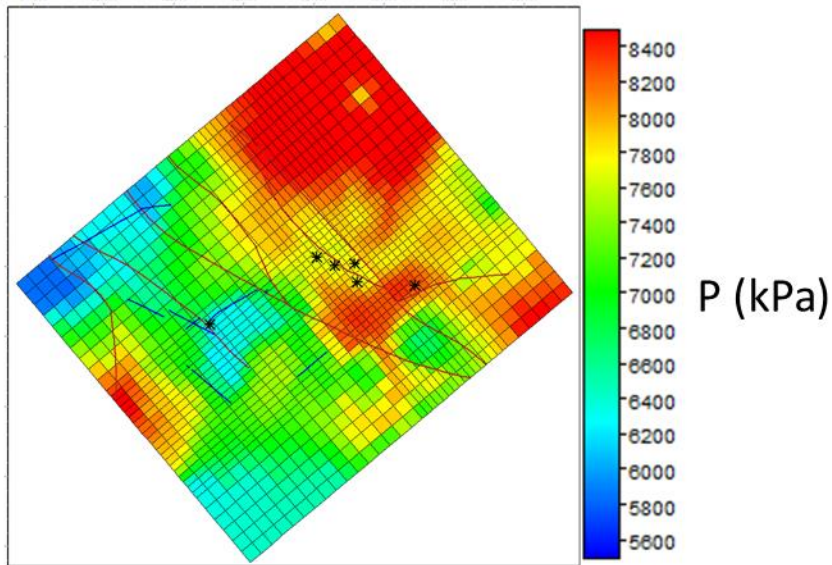# ILLUSTRATION

Structural model

Blue: conductive discontinuities (fracture corridors, deep faults)
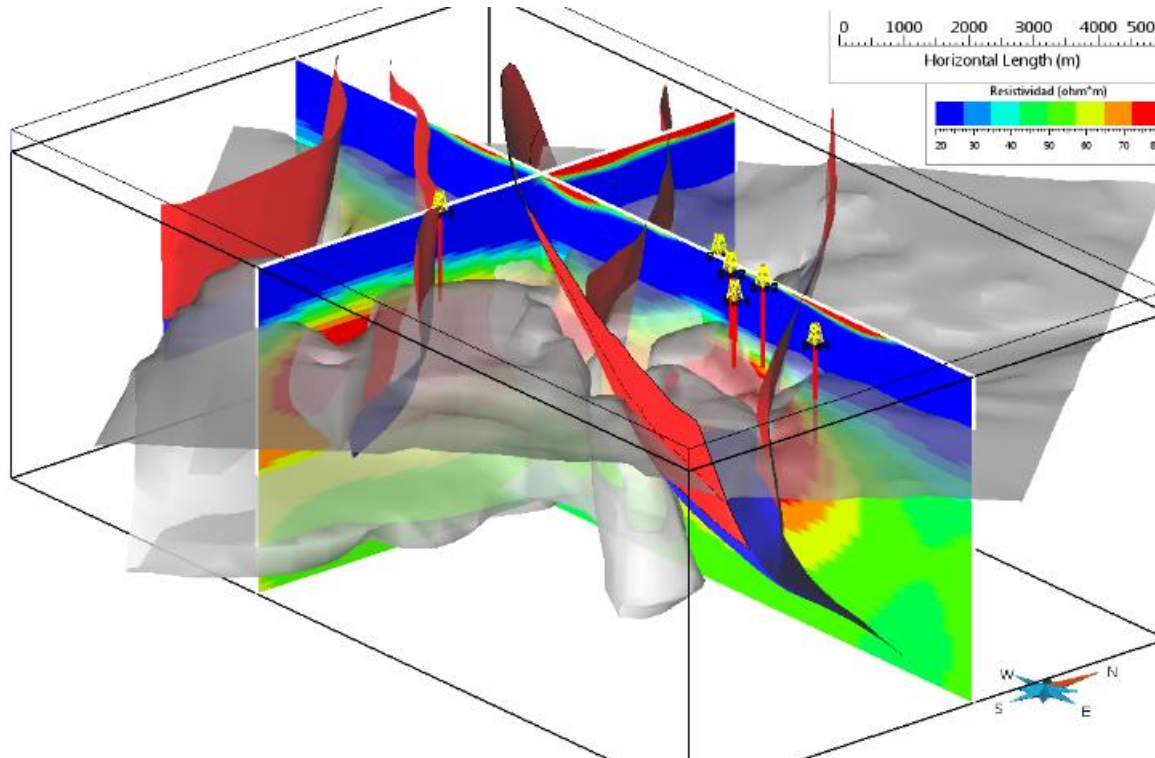Red: nonconductive discontinuities (flow barriers)

Simulation of initial conditions

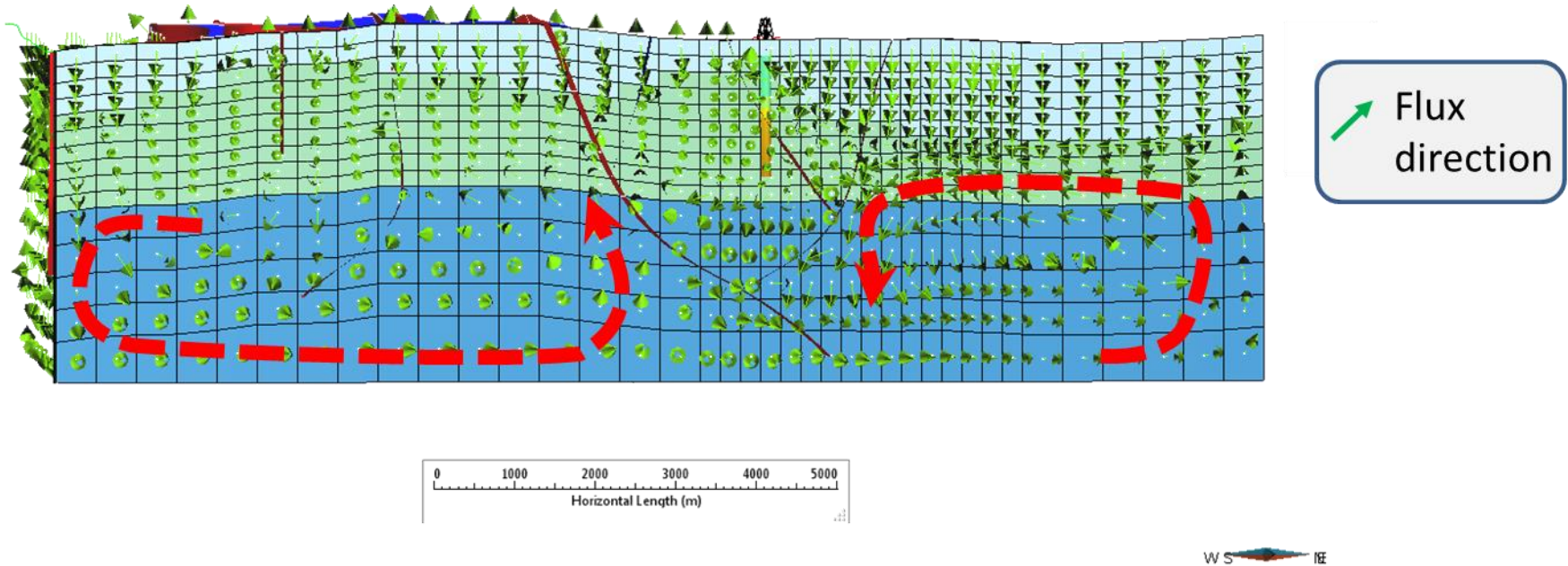- Pressure, temperature and enthalpy @ 1500 m

Simulation of initial conditions

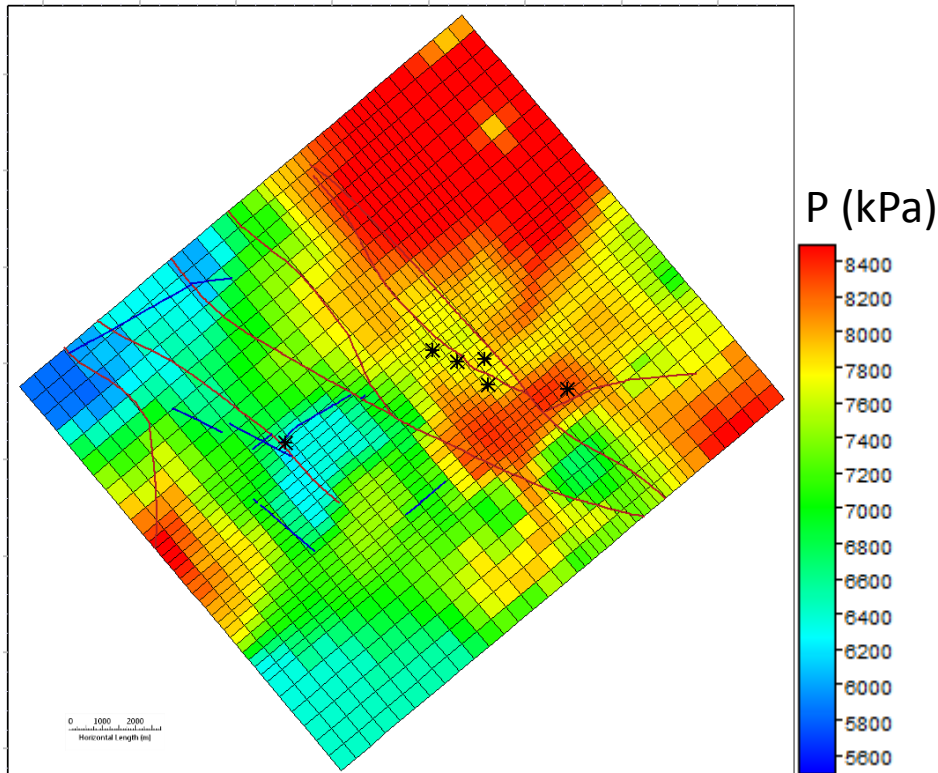- Iso-surface of T = 220°C
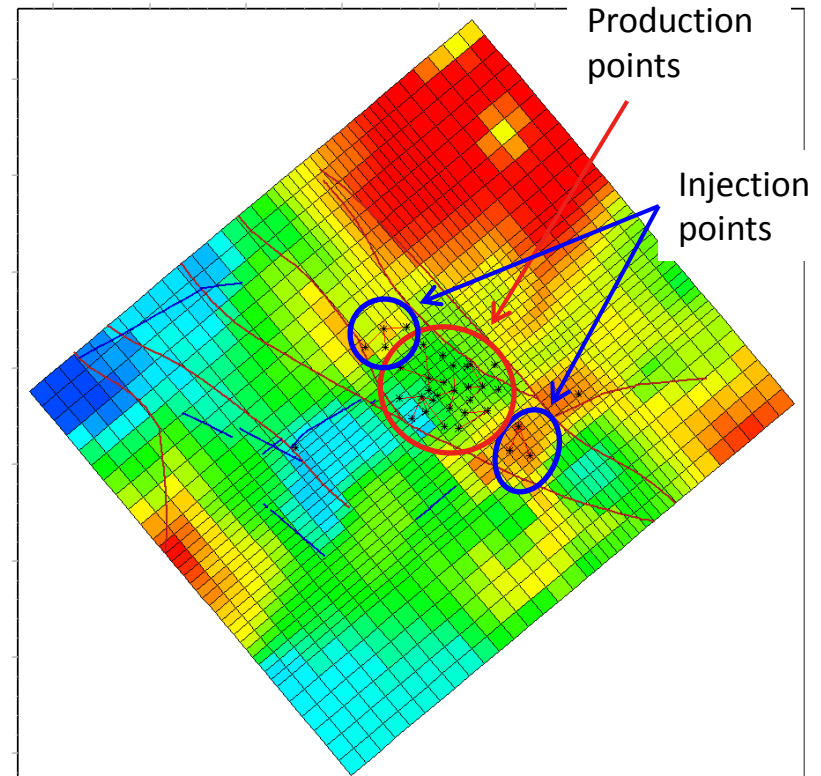
Simulation of initial conditions

- Flux vectors

Simulation of a development plan

- Pressure map @ 1500 m

Initial conditions

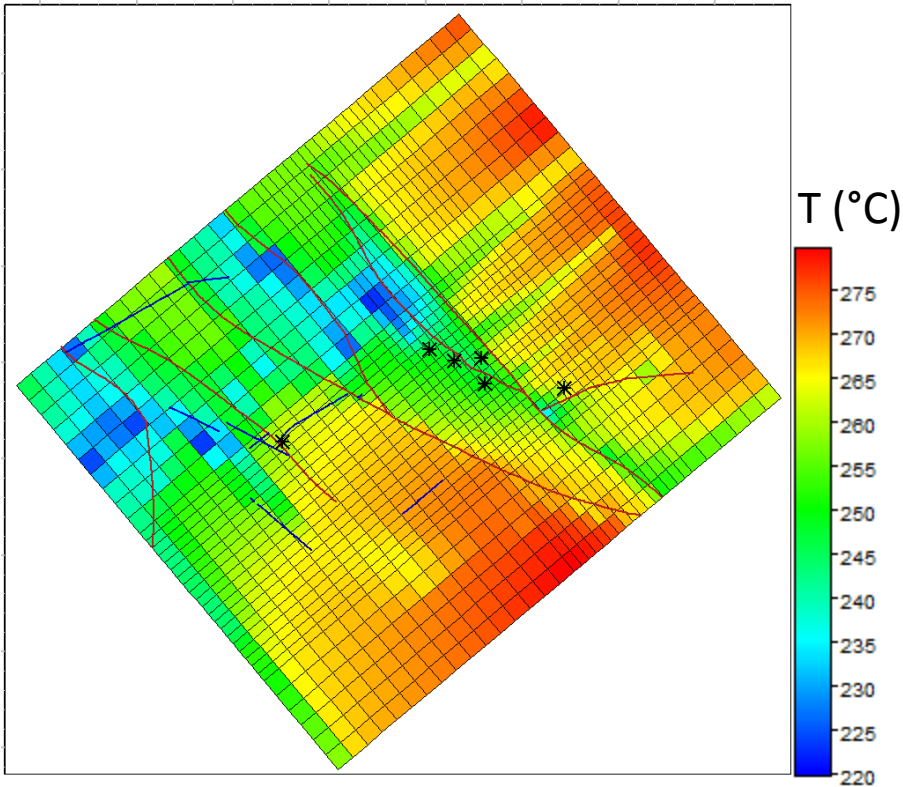Conditions after 50 years of production

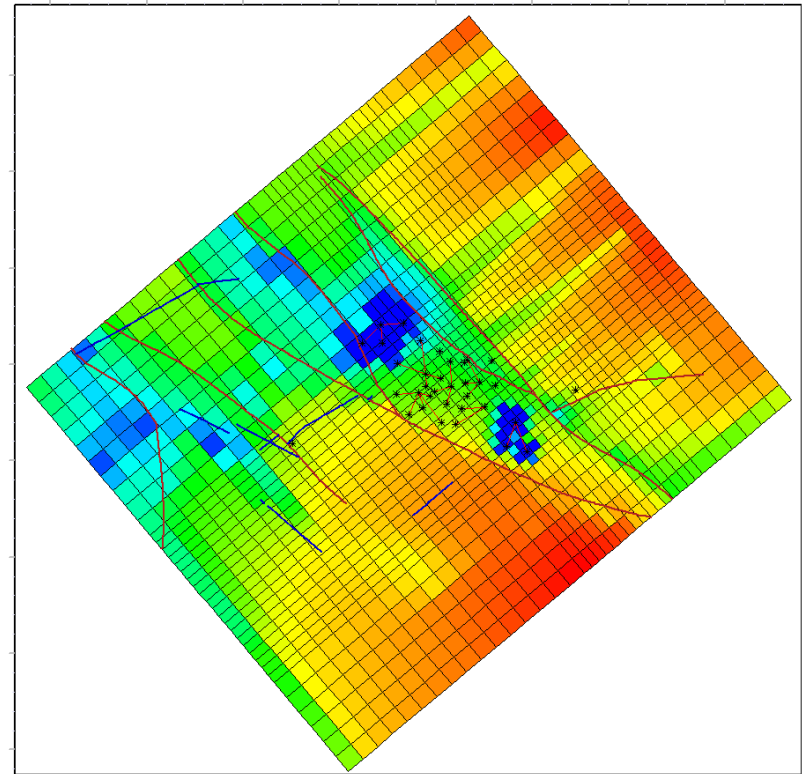Production points

Injection points

P (kPa)

Simulation of a development plan

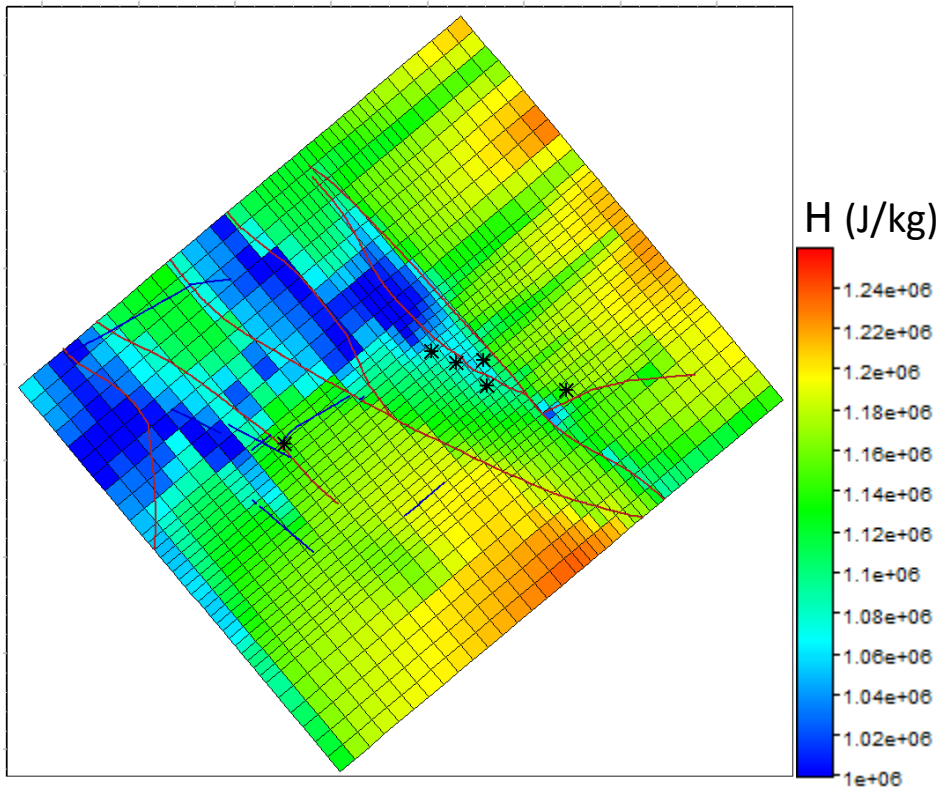- Temperature map @ 1500 m

Initial conditions

Conditions after 50 years of production

T (°C)

Simulation of a development plan

- Enthalpy map @ 1500 m

Initial conditions

Conditions after 50 years of production

H (J/kg)