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Evidence for tight aquitards & leaky aquitards

Never Stand Still

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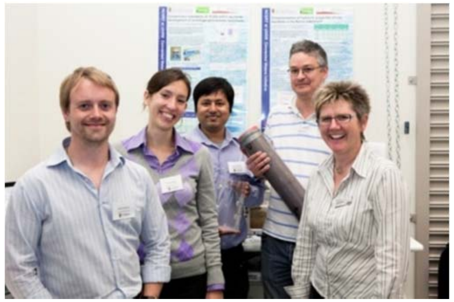


Outline

- Aquitards – key points and conceptual models
- Direct testing techniques
- Leaky aquitards
- Tight aquitards

Key points

- **Aquitards can limit potential impacts** of depressurization that is associated with underground resource extraction associated with mining and coal seam gas (CSG) development

- **Relative permeability of strata are more important** than absolute permeability, however, coupled hydro-mechanical and hydro-geochemical processes for specific geological settings.

- **Seepage** and solute transport **could be negligible** through tight aquitards except over large areas or decades to millennia.

- **Independent evidence of disconnection or connection**. – hydrochemistry, isotopes and geophysics

- **Evidence for zero permeability** (an aquiclude) over large areas requires thorough investigation and long term monitoring of response to hydraulic stresses and recovery.

What makes an aquitard leaky or tight?

A leaky aquitard could be attributed to several factors such as:

- relatively large and connected pores;
- lack of applied stress or consolidation;
- limited lateral continuity of the deposit;
- geological heterogeneity; and
- preferential flowpaths due to jointing, fractures, faults and leaky bores.

A tight aquitard occurs with favourable factors including:

- thick, laterally extensive and homogeneous geological strata;
- poorly connected pores due to cementation, clay minerals, and semi-saturated conditions;
- over-consolidated matrix; and strata that if subject to changing stresses responds by ductile and plastic deformation.
- insignificant preferential flowpaths.

Why direct testing of aquitards?

Confidence with multiple lines of evidence

Constrain numerical models that may not be unique

Core tests

+

Bore tests (eg DST, packer)

+

Pore pressure responses

(eg. aquifer-interference tests, loading responses)

+

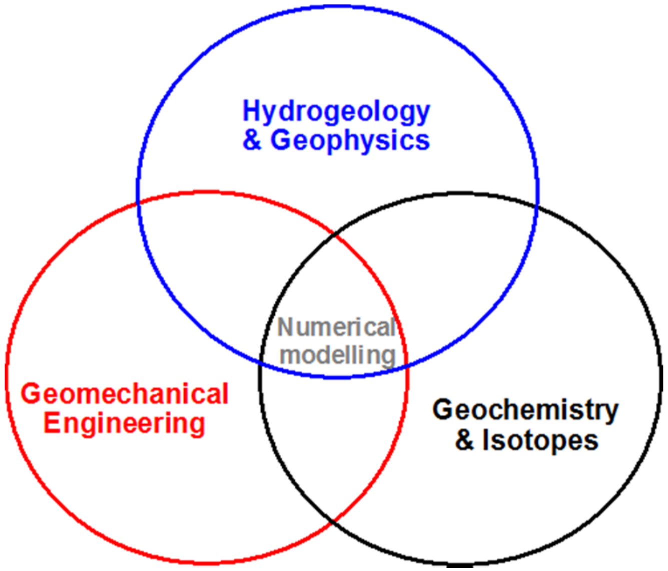
Chemical & isotopic tracers

+

Geophysics surveys of extent/heterogeneity

+

Geomechanical responses to stress/subsidence

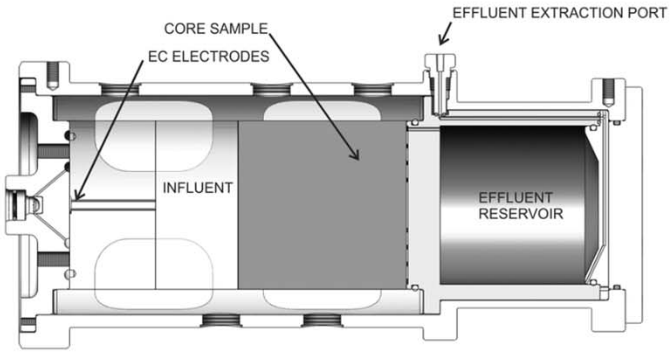


Evaluation of aquitard integrity commensurate with risk

Timms et al, 2012. *IMWA*

Geocentrifuge @ UNSW

Setup	Centrifuge Permeameter Tests
No flow	Compressibility, specific storage, solution retention capacity, pore water extraction
Transient flow	Permeability, water retention curve
Steady-state flow	Hydraulic conductivity, solute transport, effective porosity
Interrupted steady-state flow	Solute transport for dual-porosity media



ASTM standard D6527

$$K = \frac{0.248Q}{Ar_m(\omega)^2}$$

Q = the fluid flux (mL/h);

A = the sample flow area (cm^2);

r_m = the radial distance (cm); and

ω = revolutions per minute.

ASTM. 2000 “Standard test method for determining unsaturated and saturated hydraulic conductivity in porous media by steady-state centrifugation.” ASTM D6527

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