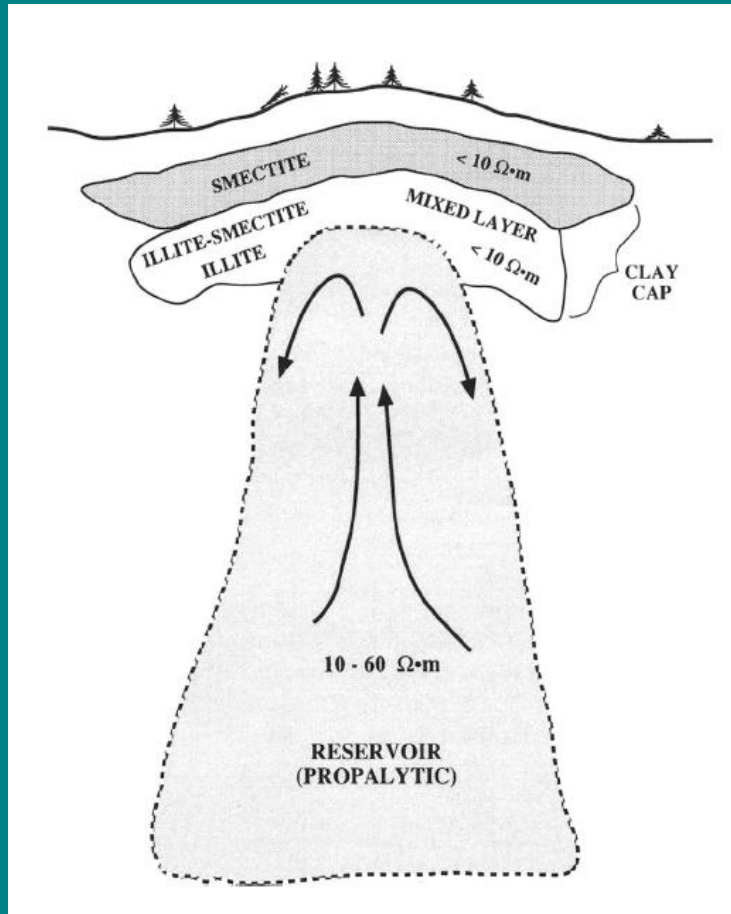


04_Magnetotellurics in geothermal exploration

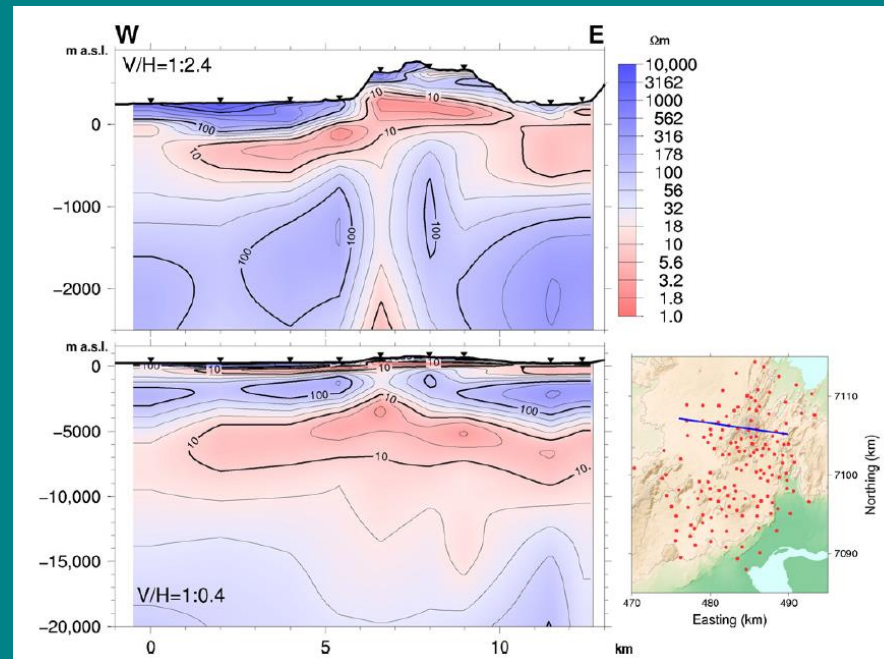
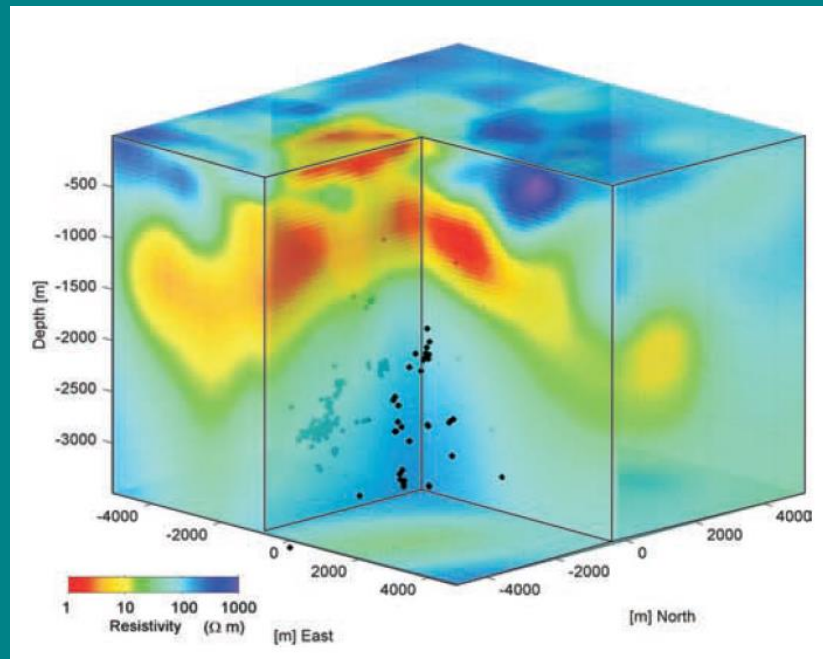
Convection-dominated geothermal play types (1)



- A volcanic type geothermal system consists of a relatively low conductivity **upflow area** overlain by a **clay-cap** of clay alteration minerals forming a highly conductive layer.
- The upflow area is characterized by an up-doming pattern of isotherms.
- It is inferred that the base of the clay-cap coincides with the temperature contour of the geothermal reservoir.

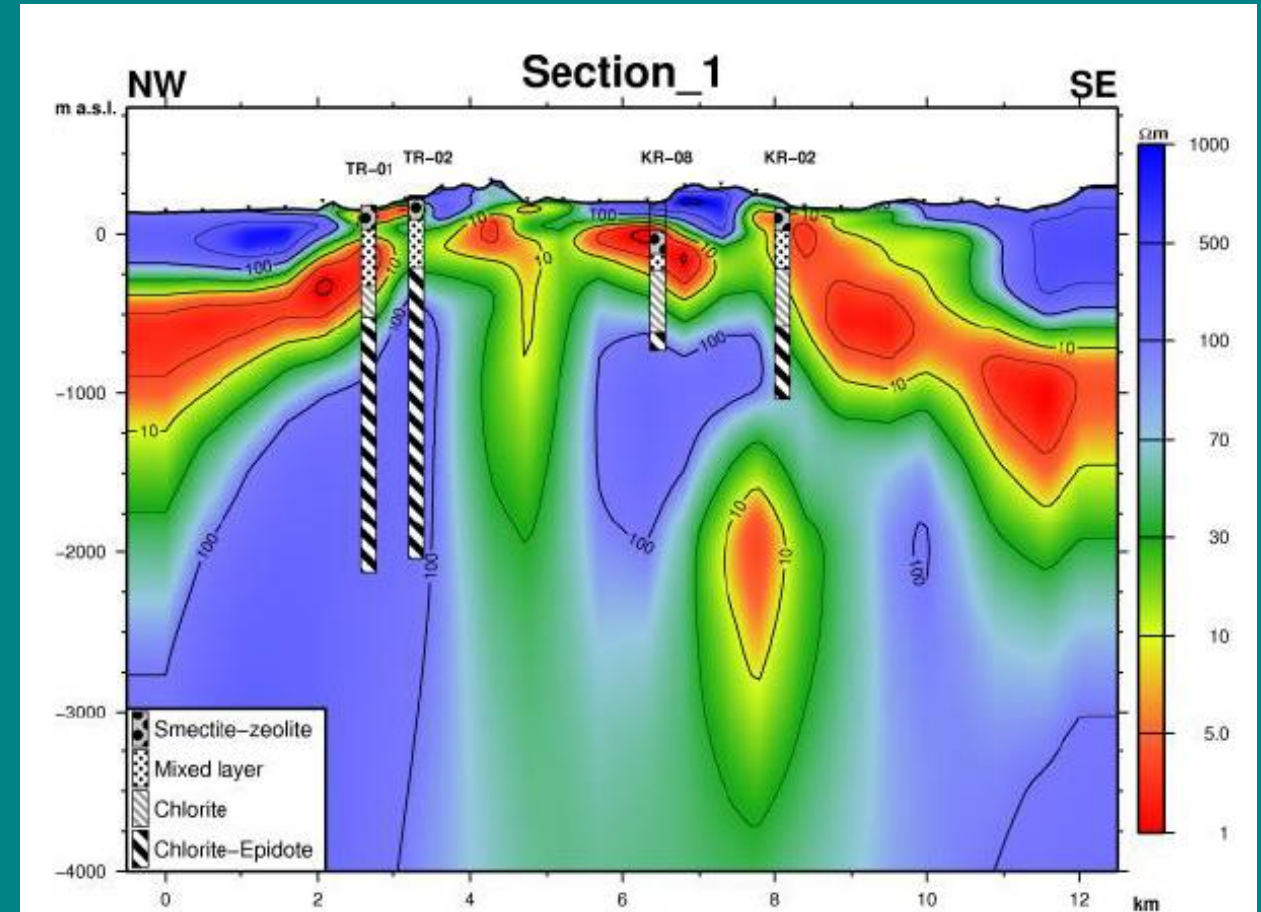
Convection-dominated geothermal play types (2)

- The Taupo volcanic zone (*Heise et al., 2008*) in New-Zealand and the Hengill area (*Árnason et al., 2010*) in Iceland are a good examples.



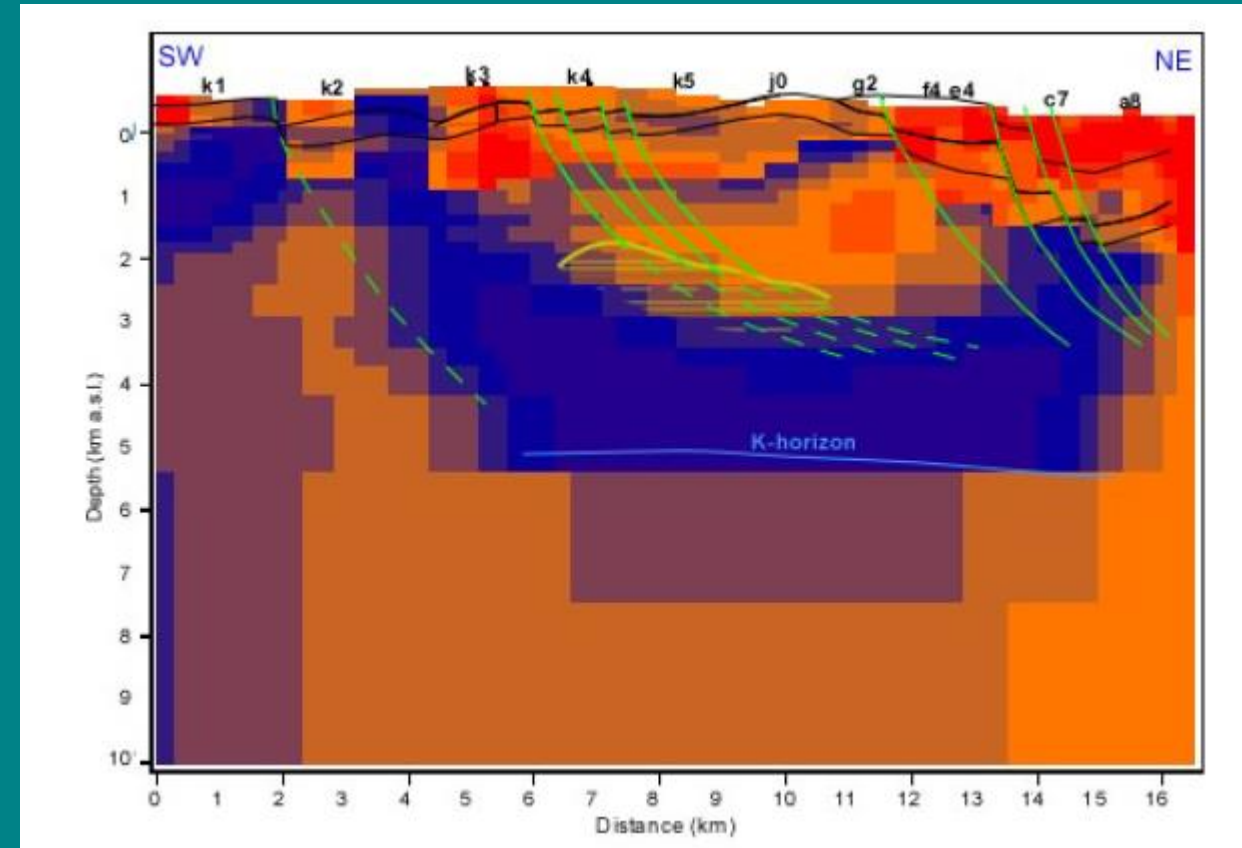
Convection-dominated geothermal play types (3)

- The Krýsuvík geothermal area in Iceland not so much:
 - The deep conductor is not related to an upflow zone.
 - Recovered temperatures are lower than clay alteration mineralogy suggests.



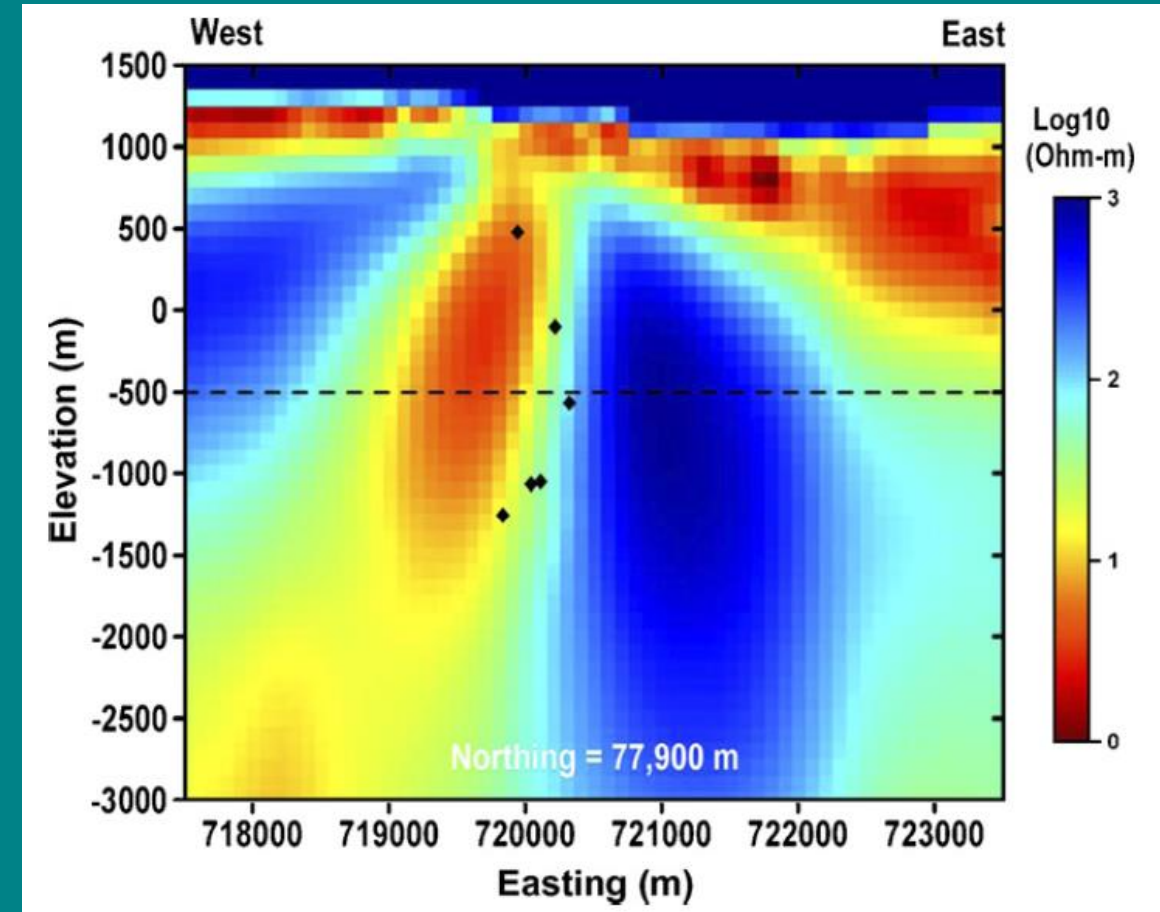
Convection-dominated geothermal play types (4)

- The Travale geothermal field (*Manzella et al., 2006*), Tuscany, Italy, is a plutonic type geothermal play.
 - Fluid flow fault controlled
 - Permeability and possibility clay alteration coincident with low resistivity (red colors).



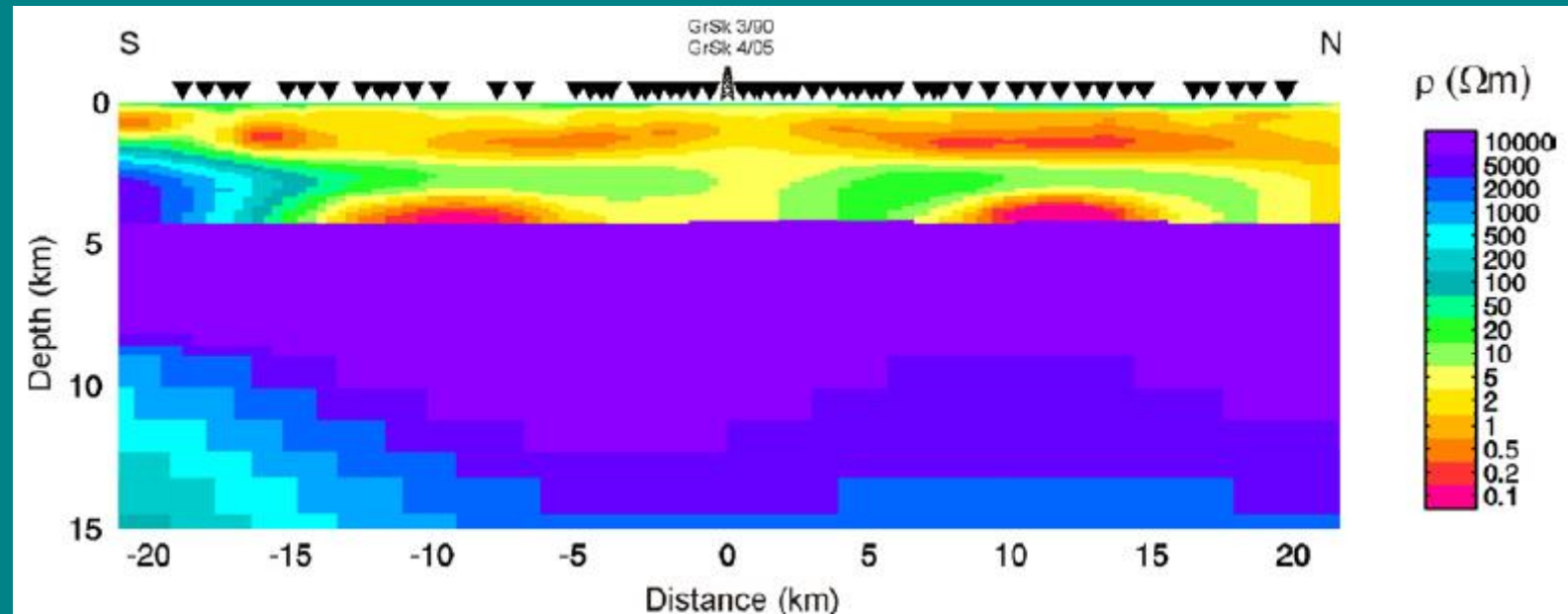
Convection-dominated geothermal play types (5)

- Extensional domain geothermal play type resistivity structure illustrated by the Coso geothermal field (*Wannamaker et al., 2005*)
 - Upwards moving magma reservoir
 - Geothermal reservoir permeability fracture controlled.
 - Low resistivity related to fluid flow.
 - Shallow resistivity layers related to hydrothermal alteration.



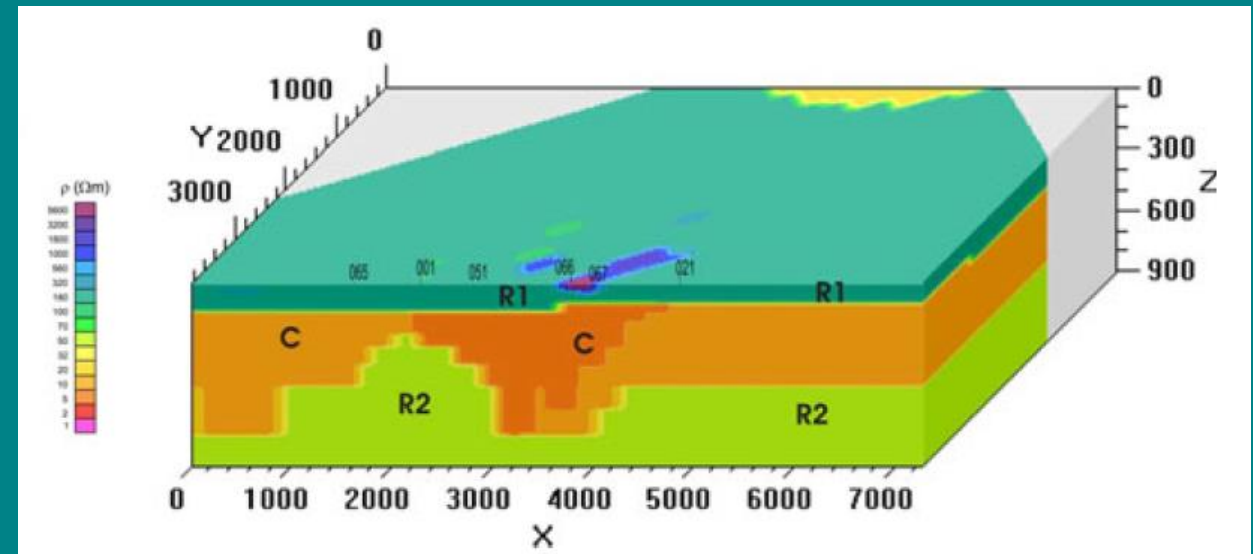
Conduction-dominated geothermal play types (1)

- An example of an intracratonic basin type system is Gross-Schönebeck (*Munoz et al, 2010*).
 - Imaged by joint interpretation of MT and seismic data.
 - Aquifers are deep sandstones and volcanic strata.
 - Enhanced permeability in conductive anhydrites.



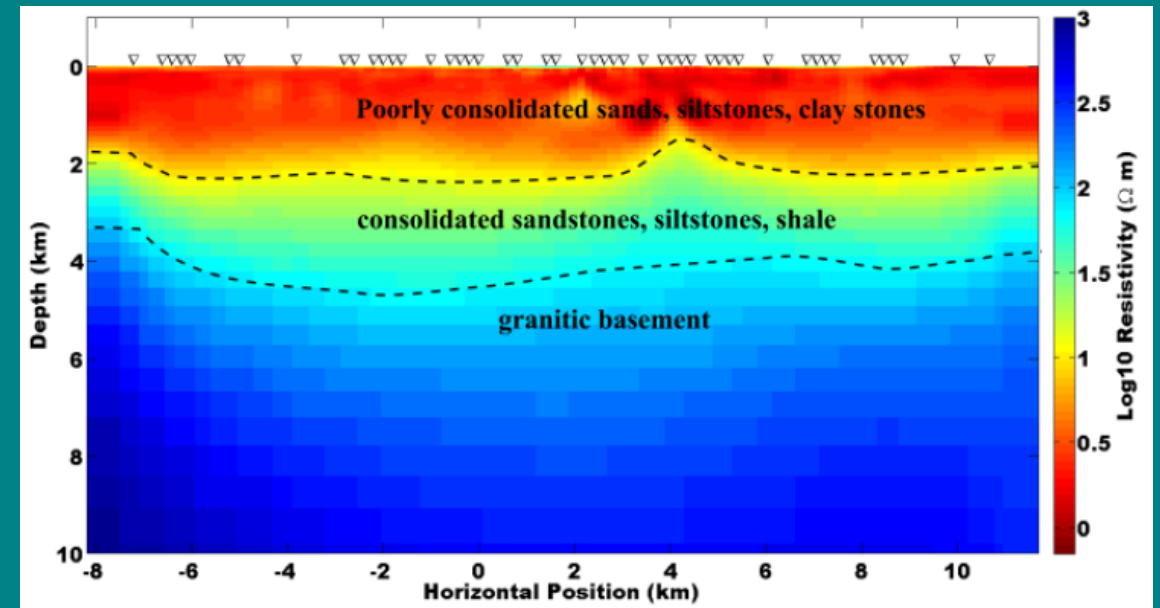
Conduction-dominated geothermal play types (2)

- An orogenic belt type setting geothermal system is the Llucmajor aquifer system (*Arrango et al., 2009*).
 - Two moderate resistive aquifers connected by a fault.
 - Low resistive aquitard.
 - Same exploration strategy as intracratonic basin type plays.



Conduction-dominated geothermal play types (3)

- Didana et al. (2015), used MT to image a basement type geothermal play.
 - Three layer model consisting of unconsolidated conductive sediments, consolidated moderately resistive sediments, and a resistive basement.



Case studies Indonesia