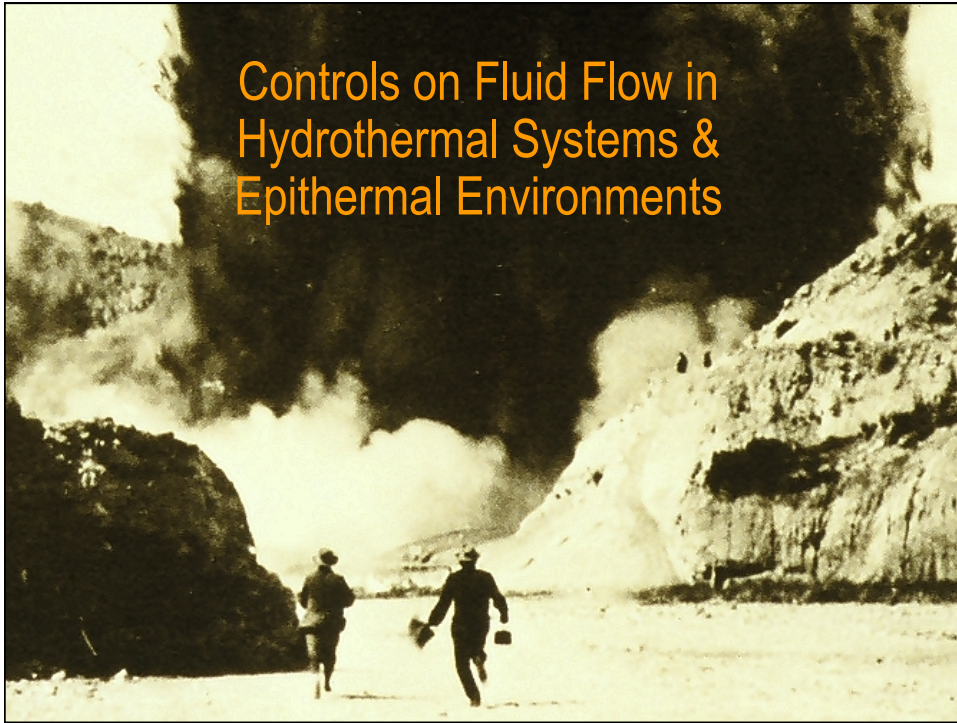


Controls on Fluid Flow in Hydrothermal Systems & Epithermal Environments



What controls fluid flow in
hydrothermal systems?

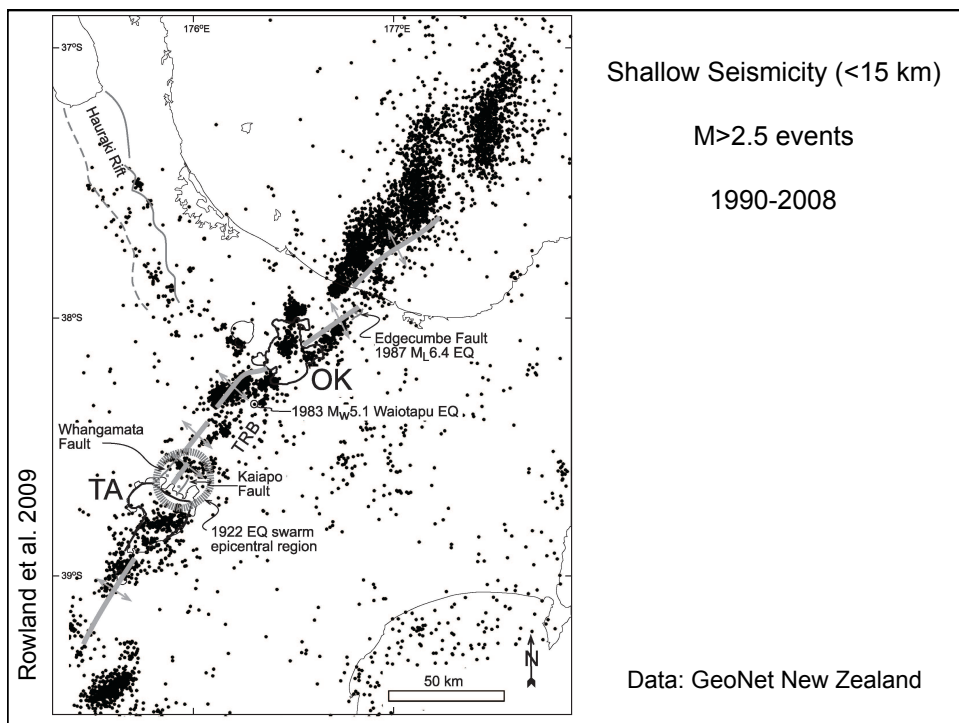
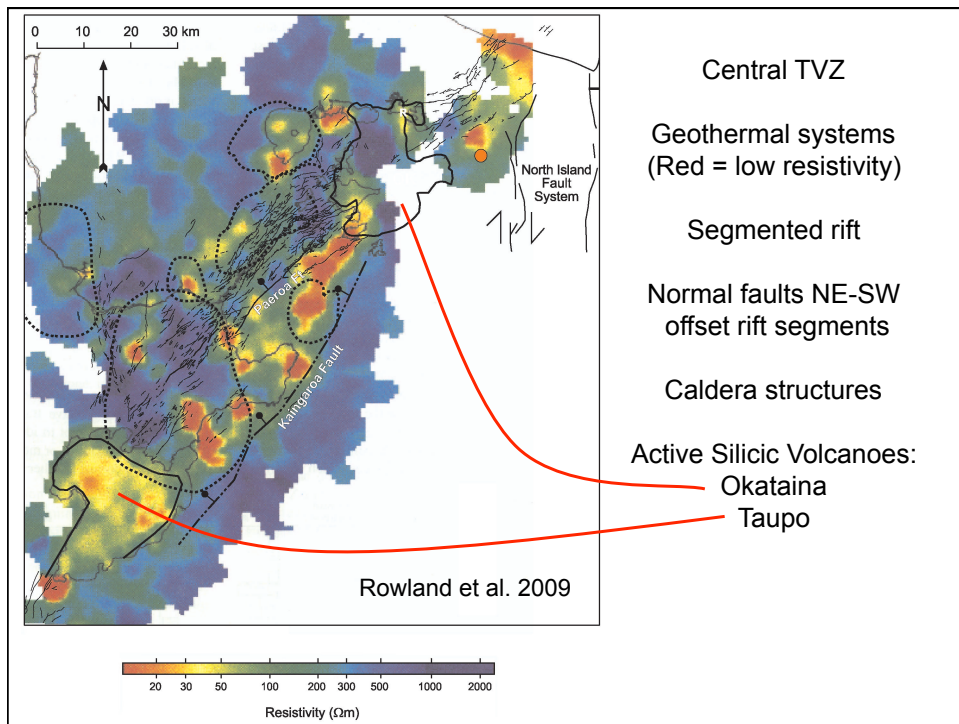
magmatic intrusions
country rocks
faults & fractures
hydrothermal alteration
mineral dissolution-precipitation

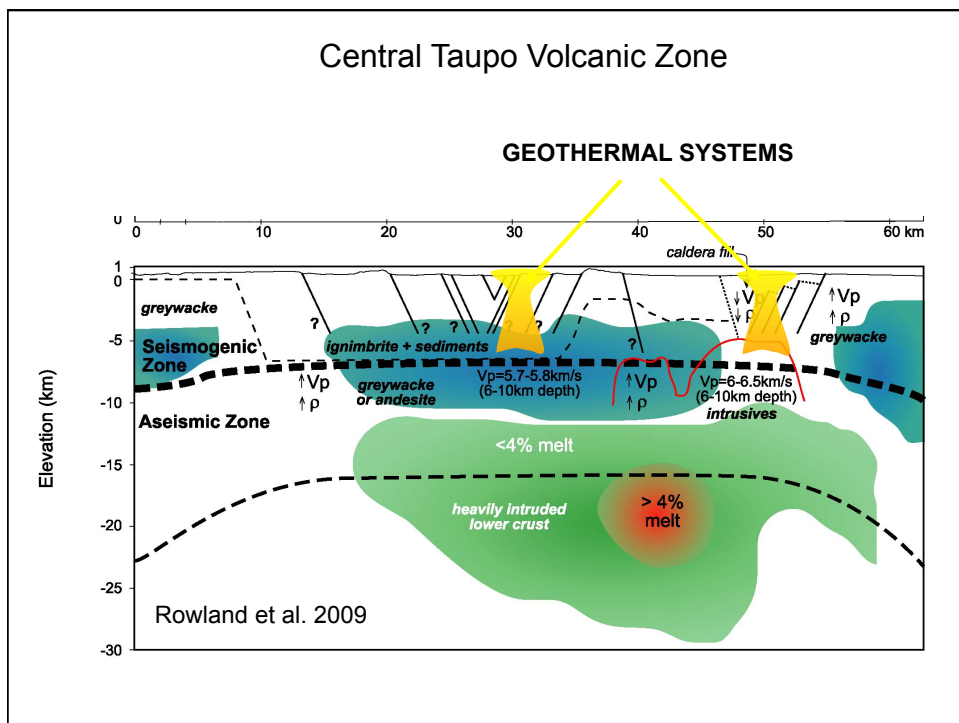
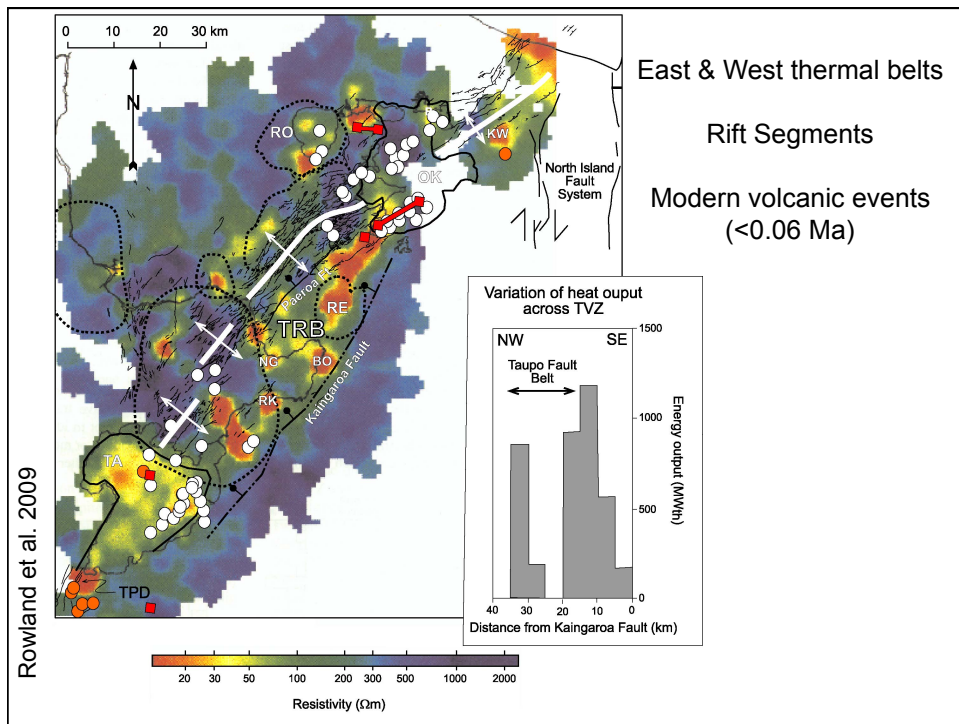
Scale dimensions of controls,
e.g., Taupo Volcanic Zone.

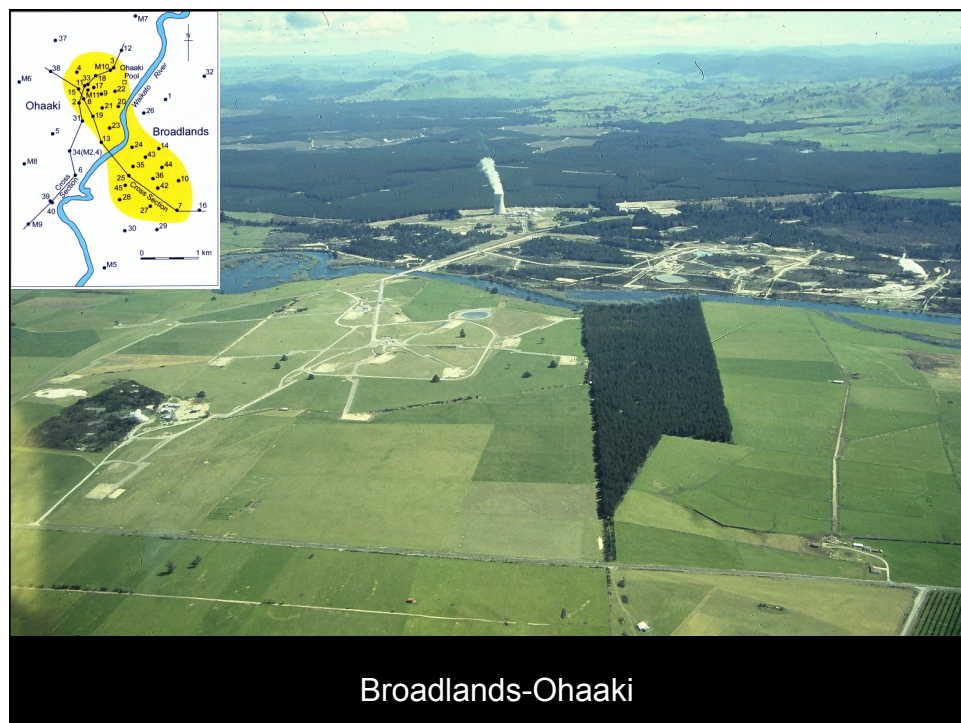
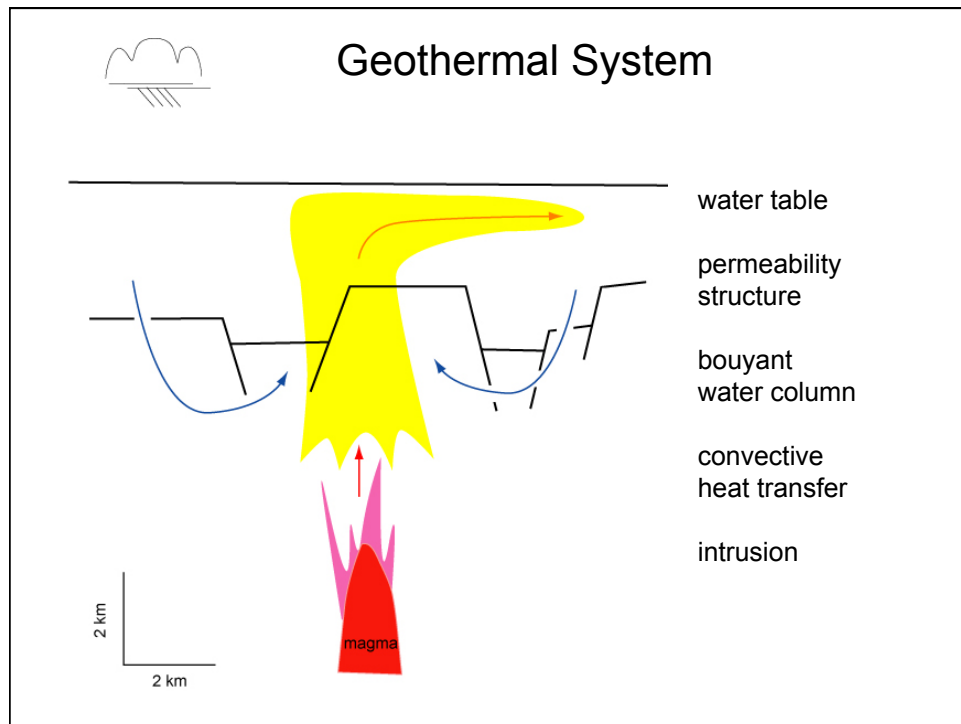
Complex & simple flow networks



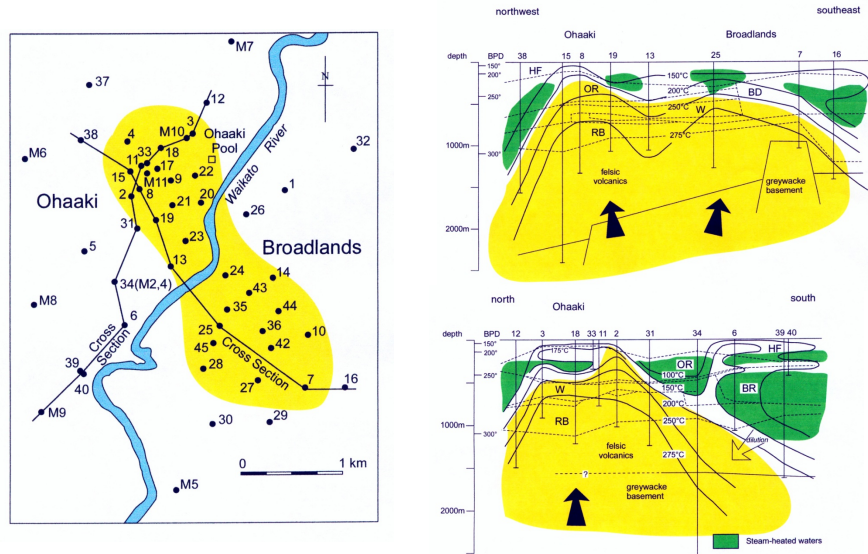
Rotorua Geyser



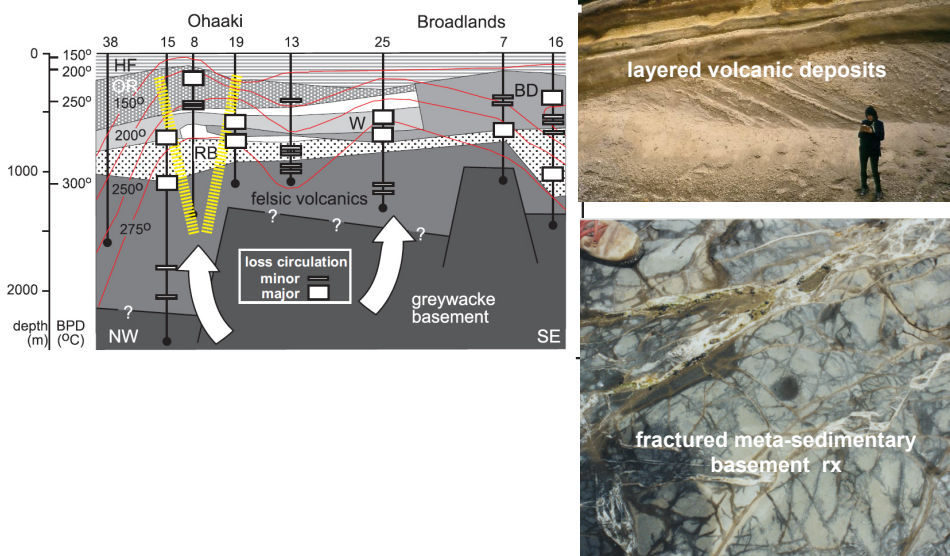




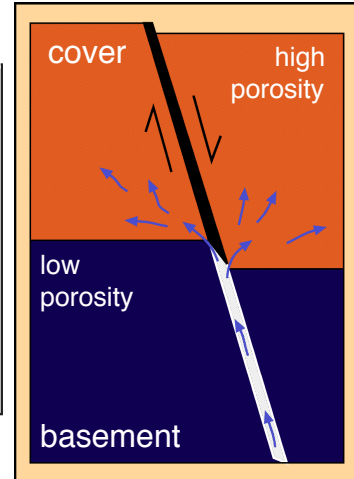
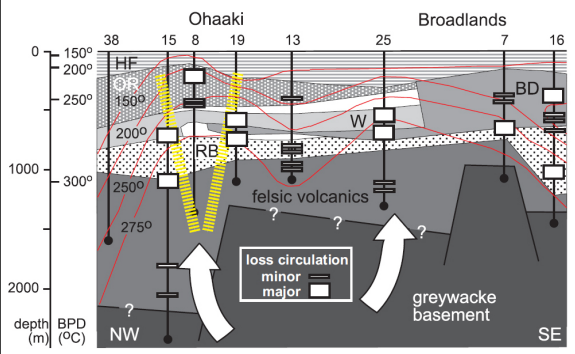
Broadlands-Ohaaki



Broadlands-Ohaaki

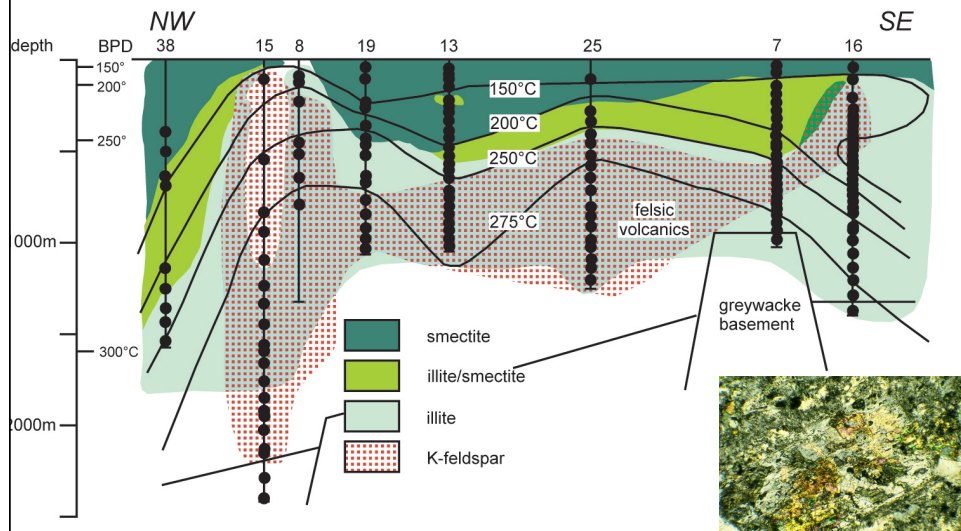


Broadlands-Ohaaki



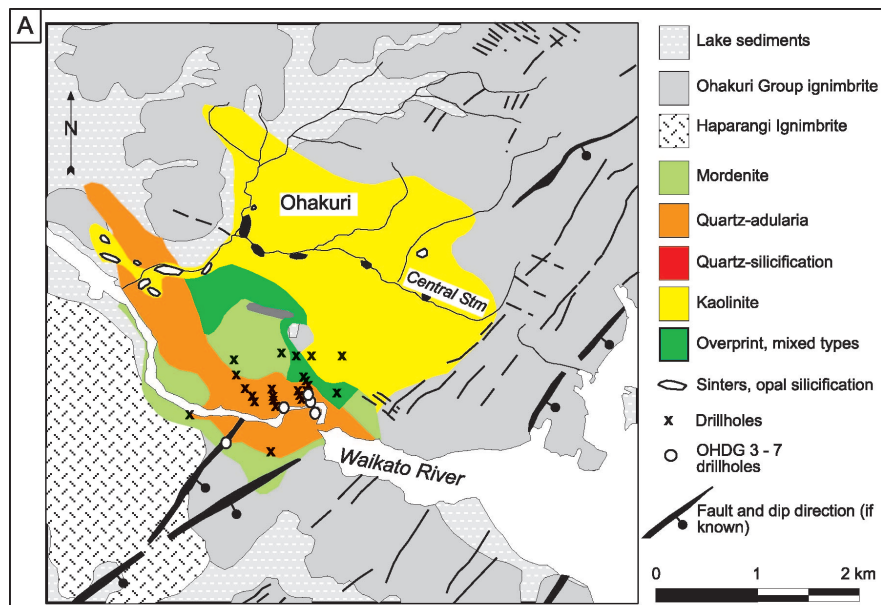
Static fault-fluid interactions

Broadlands-Ohaaki



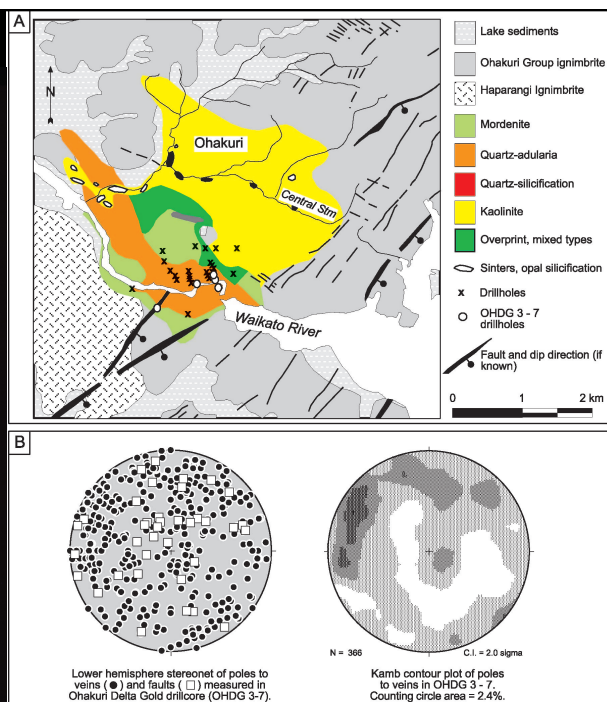
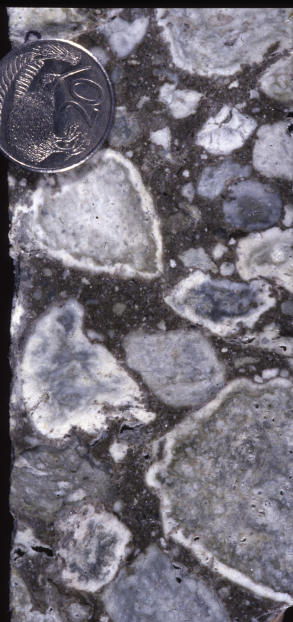
hydrothermal minerals & alteration patterns

Ohakuri: Epithermal prospect (inactive)



after Henneberger & Browne 1988

Ohakuri

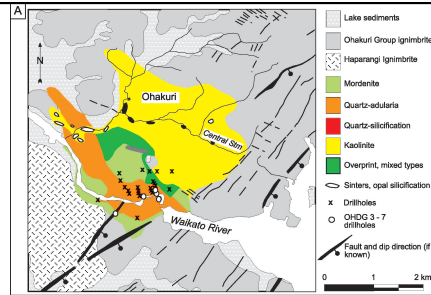


Ohakuri

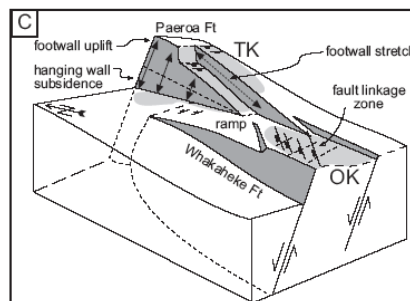
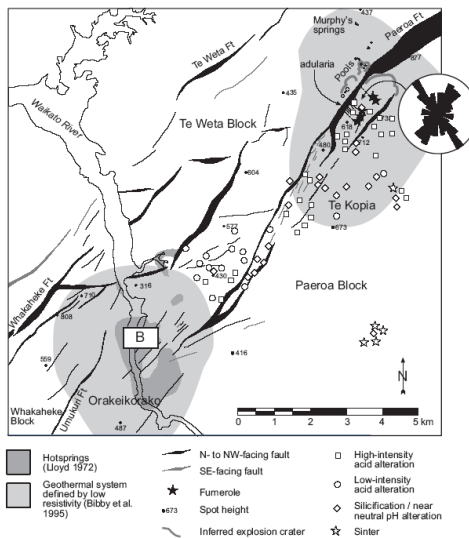
>2 million oz dis Au (<1 ppm)

Round Mountain analogue

Veins discontinuous & anastomosing

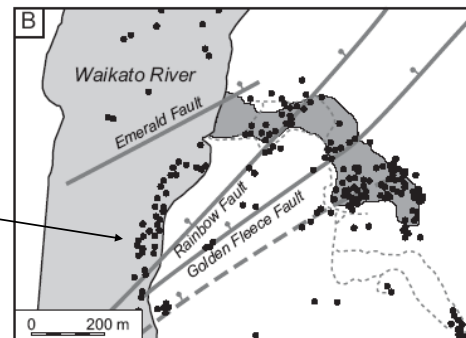


Geothermal Hydrology-Faults



Geothermal Hydrology-Faults

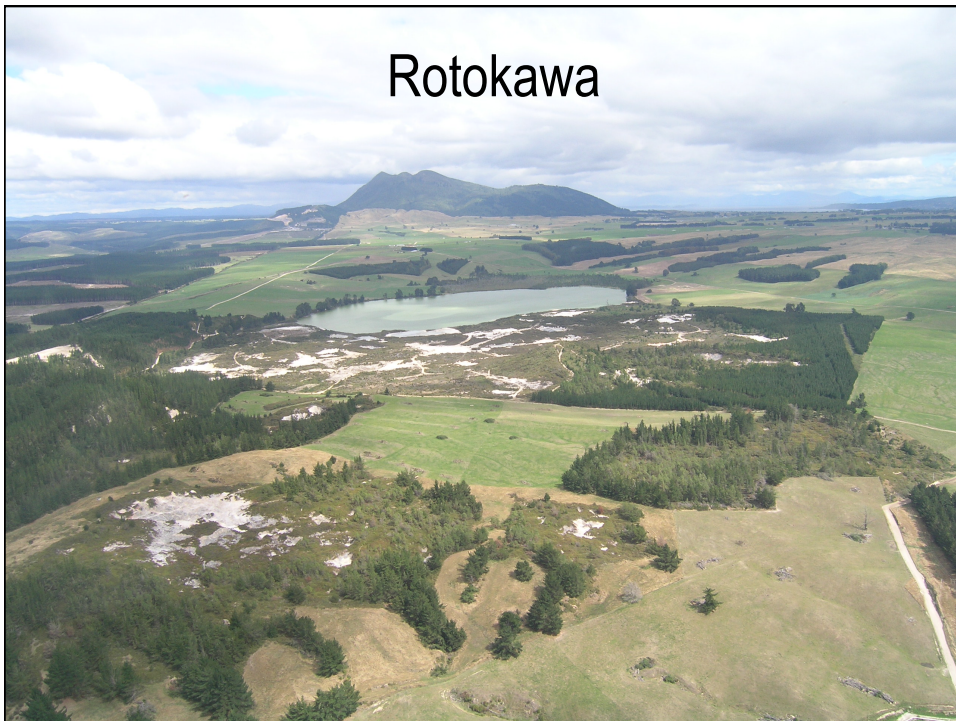
What controls distribution
of hot springs?



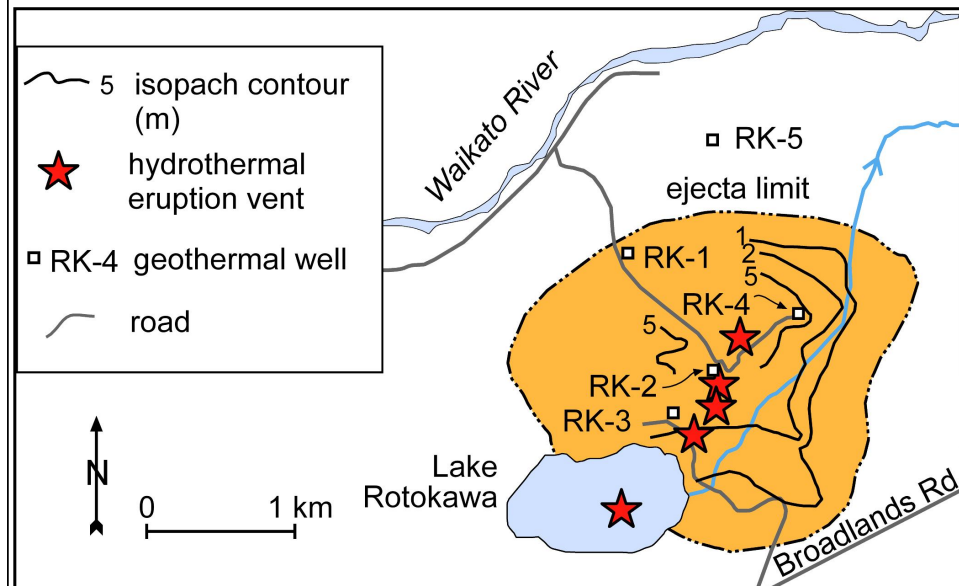
Rainbow fault draped by
silica sinter



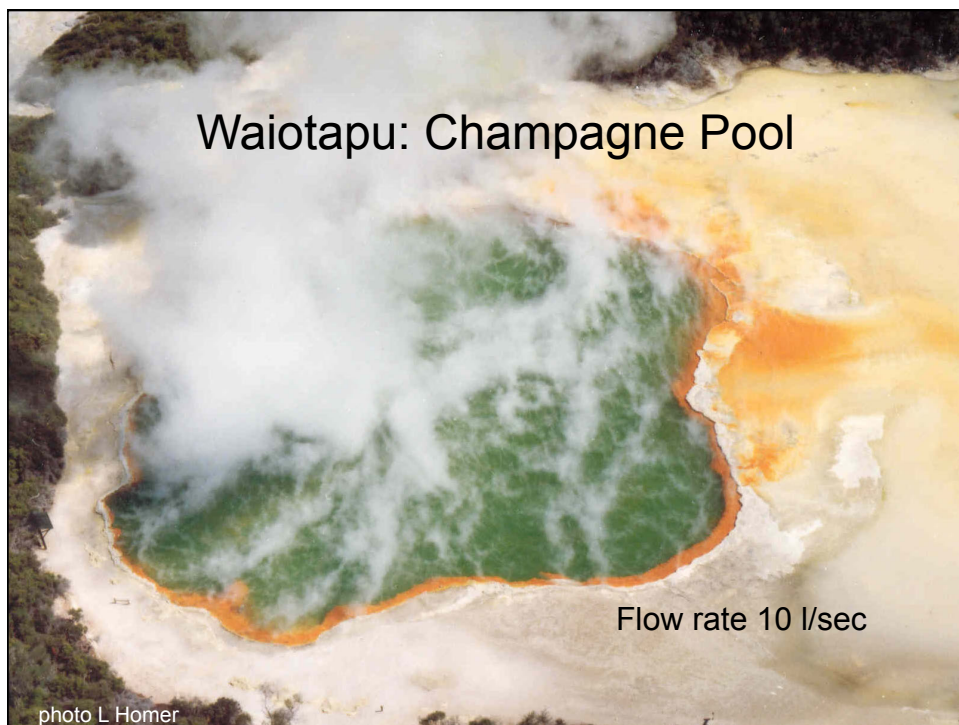
Rotokawa

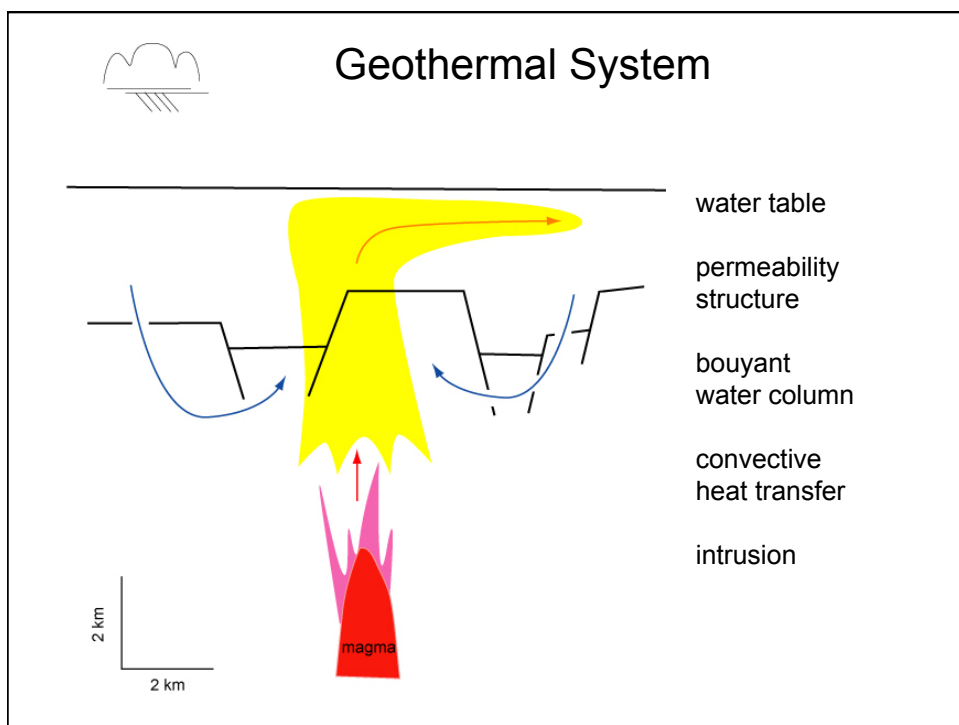
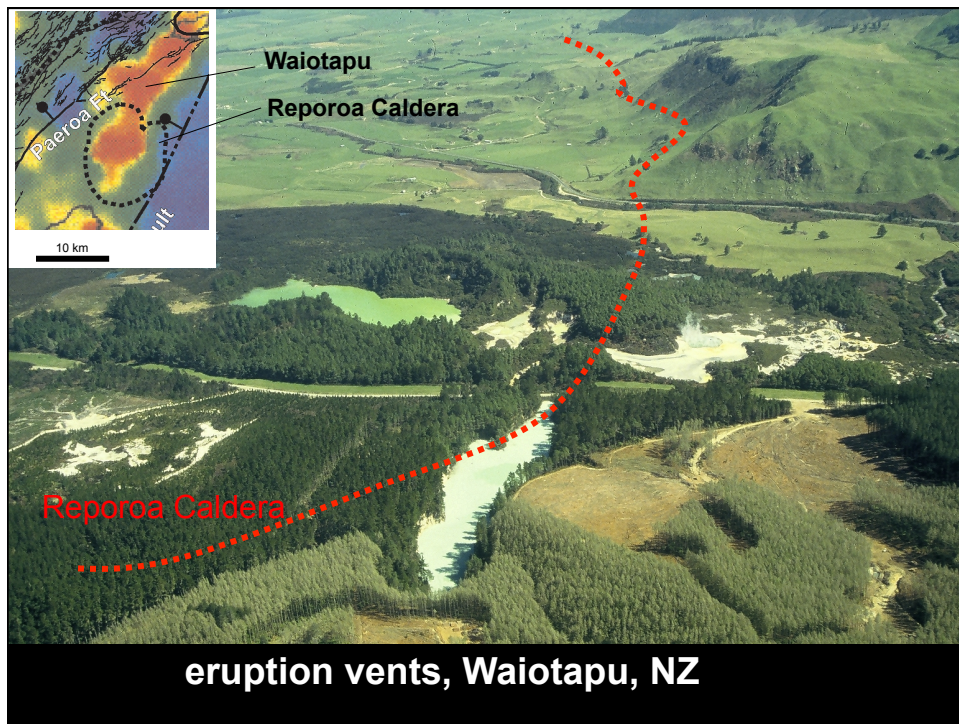


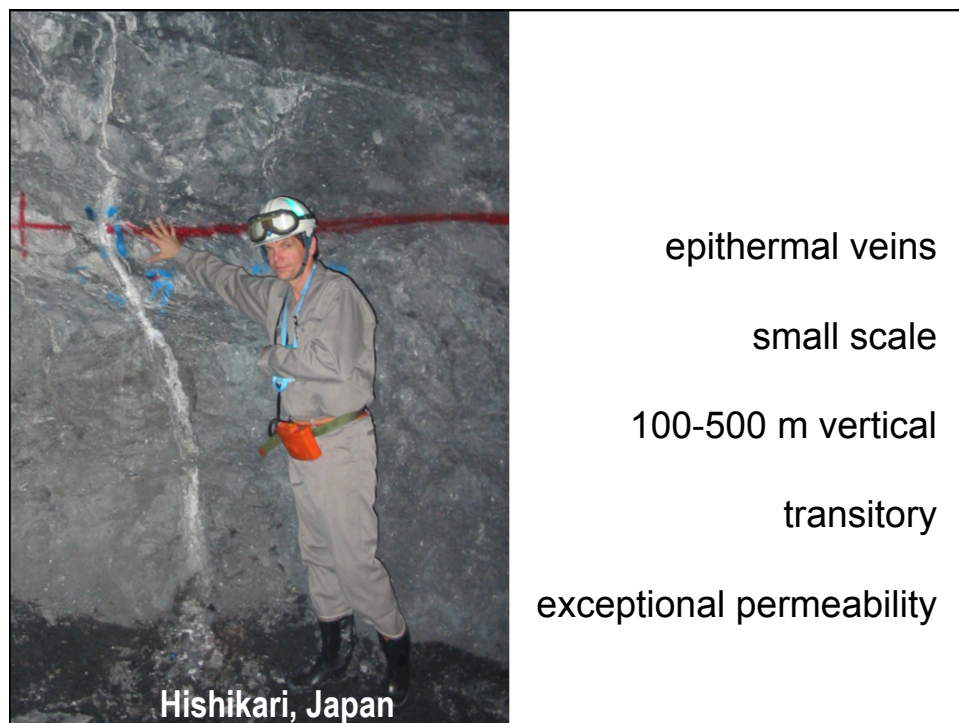
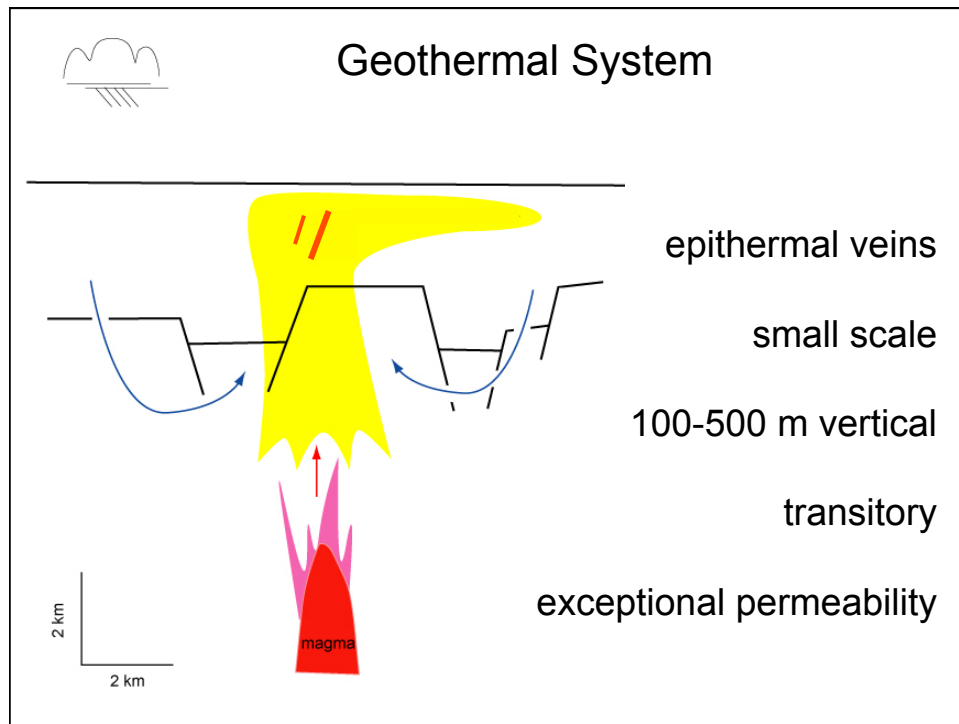
Rotokawa



Waiotapu: Champagne Pool







VEIN GEOMETRY



epithermal veins

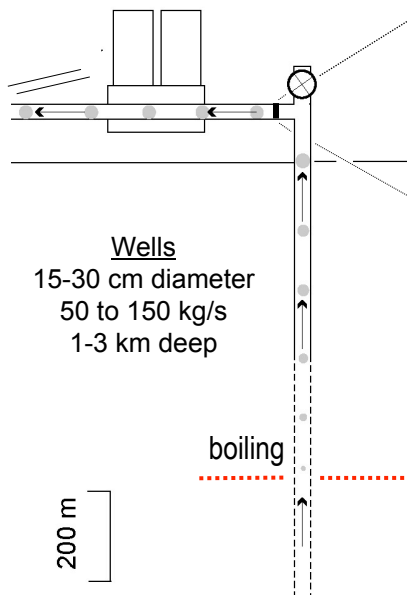
small scale

100-500 m vertical

transitory

exceptional permeability

2 phase (boiling) well



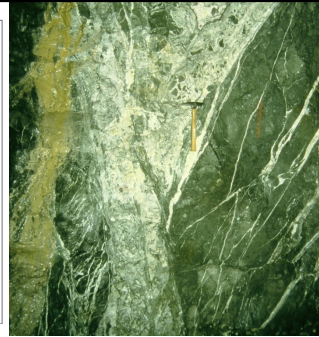
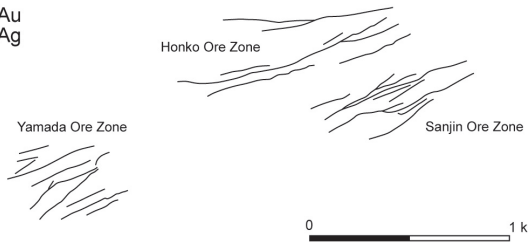
chalcopyrite scale
60,000 ppm Au
>100,000 ppm Ag

solution
1 ppb Au
8 ppb Ag

Brown, 1986

Hishikari

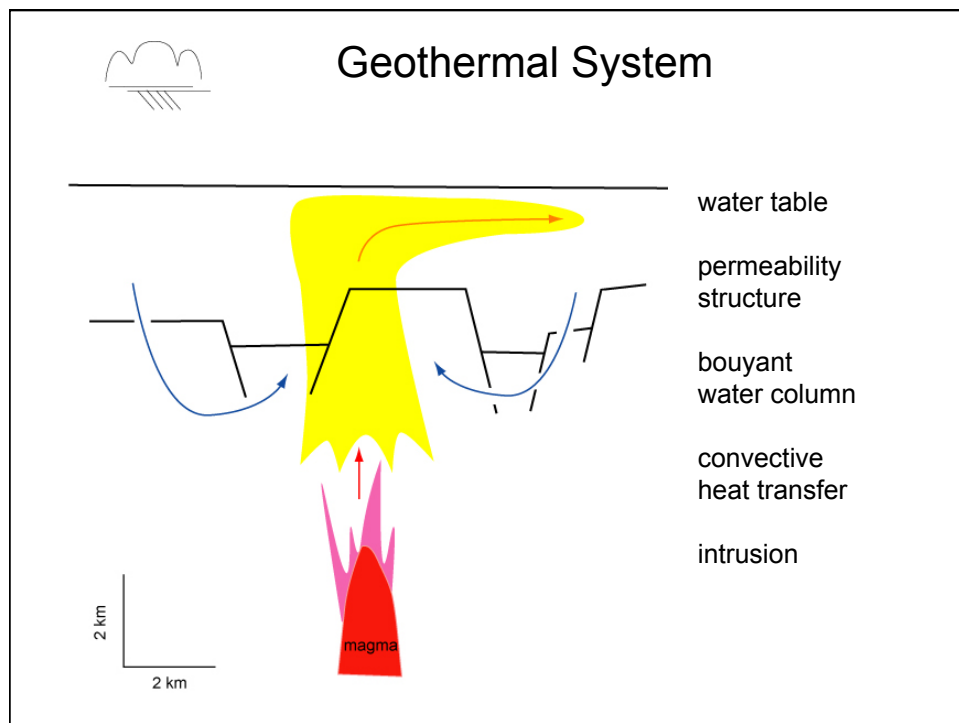
260 t Au
175 t Ag

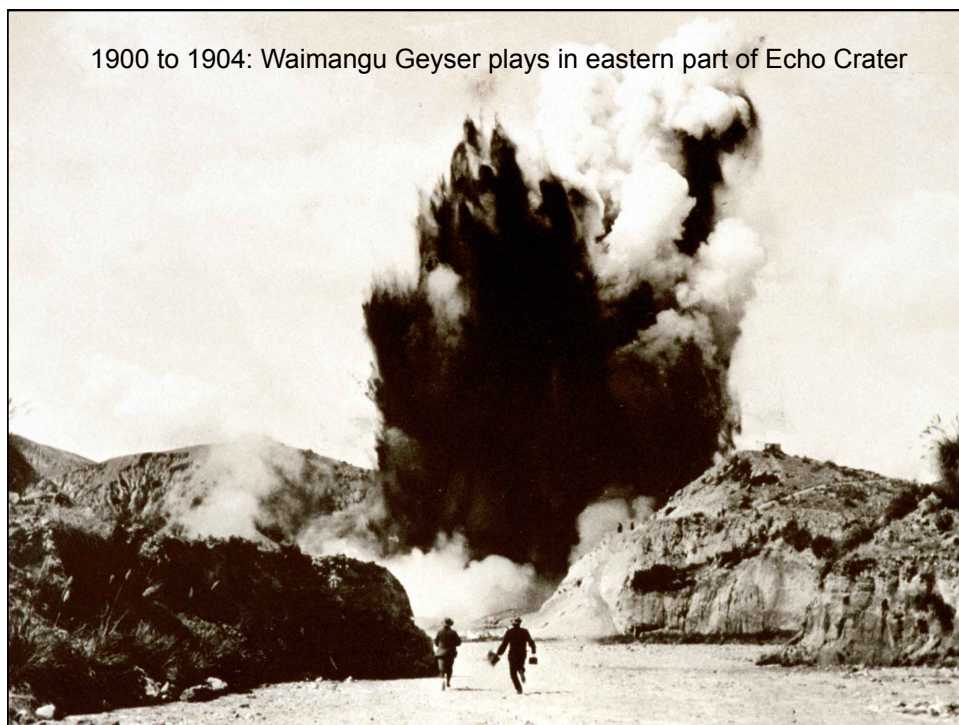
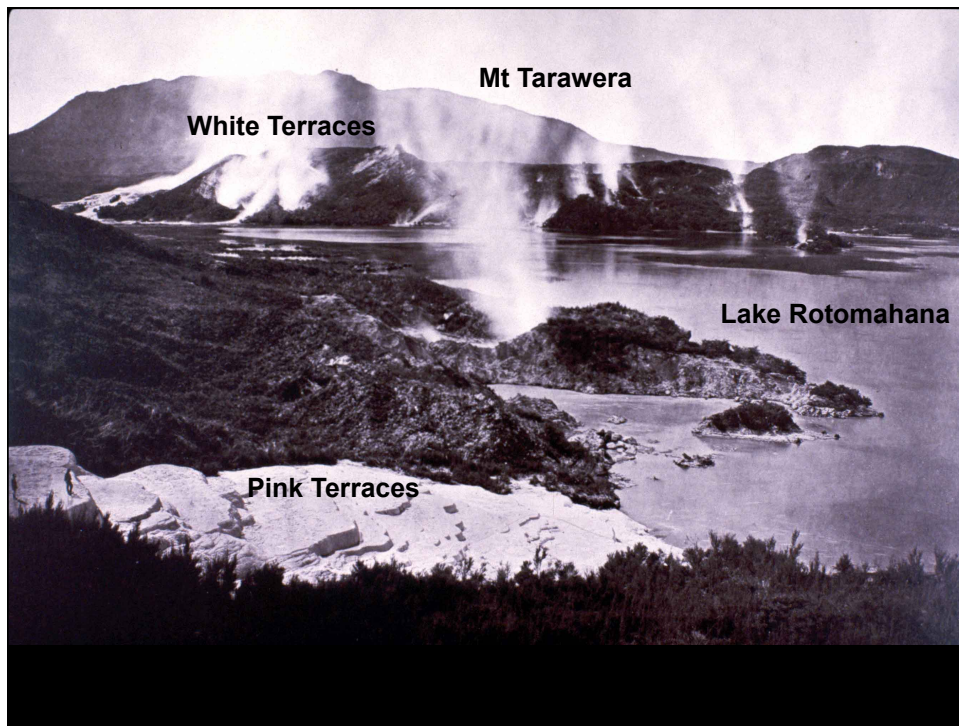


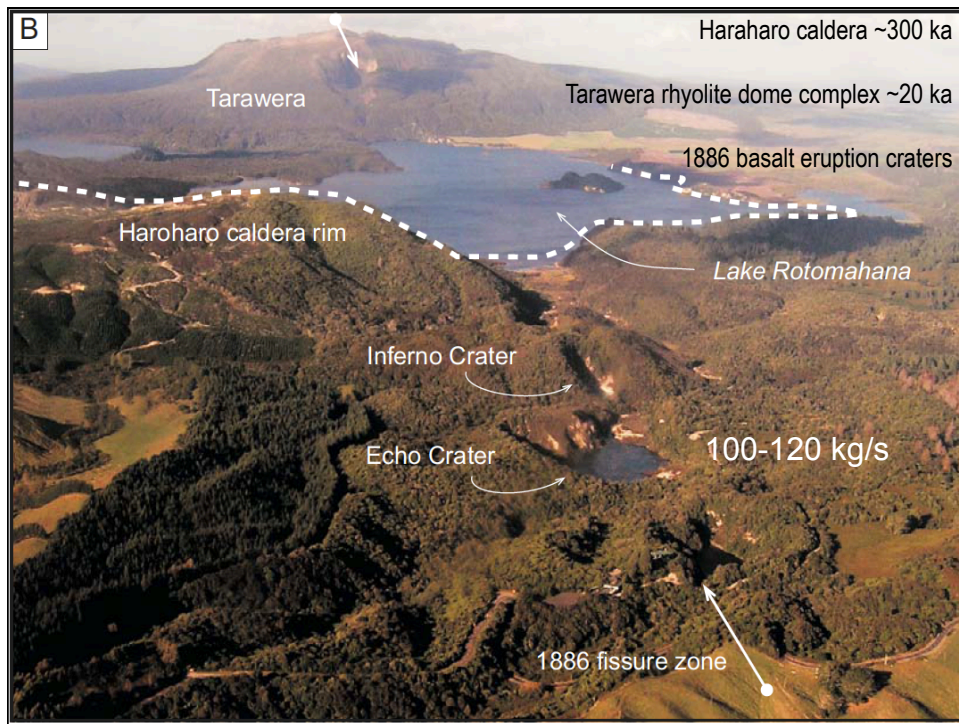
Extensional-transtensional structures → small differential stress.

High fluid flux over short periods: $\ll 1000$ yrs

Vein filling ~ several short lived flow events separated by long periods of quiescence (Sanematsu et al. 2006).



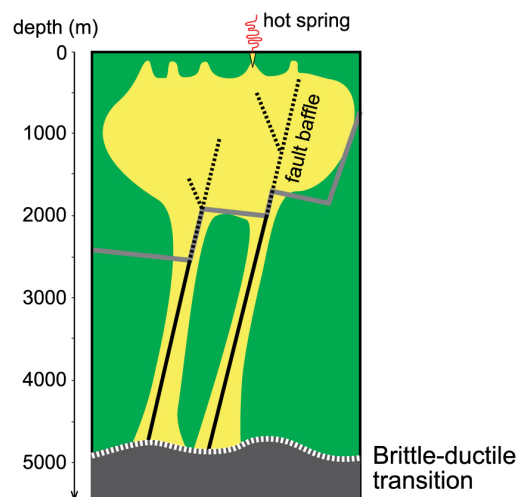




Summary

The long term transfer of energy via hydrothermal fluid flow is modulated by permeability structure which varies in space and time.

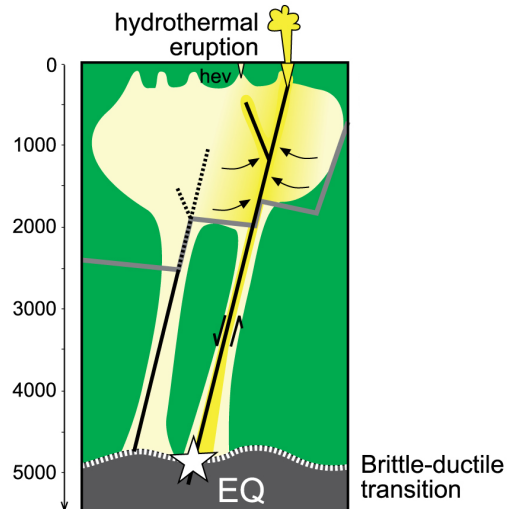
A complex network of fluid pathways is required and characteristic of geothermal reservoirs.



Summary

High fluid flux structures form a short circuit that redistributes much of the fluid flow and focus discharge due to seismic and/or volcanic and/or magmatic processes.

The extensional fracture that hosts the high flux structure and forms the vein requires small scale differential stress to form.



Summary

High fluid flux structures form a short circuit that redistributes much of the fluid flow and focus discharge due to seismic and/or volcanic and/or magmatic processes.

Dike intrusion is a second process that can form extensional fractures and high fluid flux structures.

