Geothermal Asset Management

Reservoir and Process Chemistry – Recent Work

Brian Lovelock. NZGA, June 2018

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Agenda

1. Exploration
2. Reservoir Management
3. Power Plant Steam Purity
4. Scale Control

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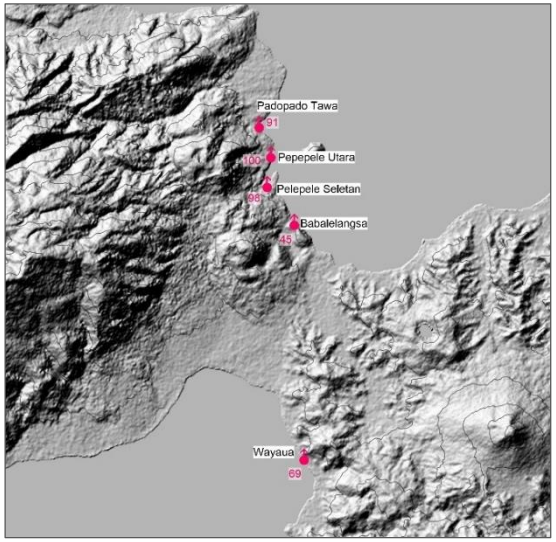
Surface Exploration

Increasingly challenging with:

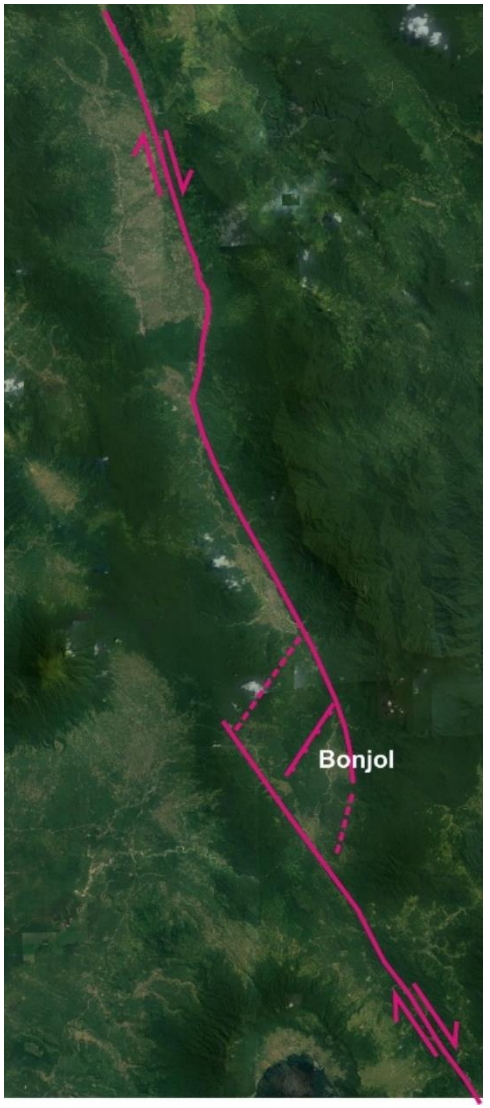
- Acidic Systems
- Seawater Systems
- Medium-Enthalpy Systems

Gunung Talang, West Sumatra



Songa Wayaua, North Maluka

Great Sumatra Fault
West Sumatra



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Resource Assessment

- With experience of many different geothermal systems, patterns in resource character become evident. This knowledge of analogous systems adds confidence to:
  - Conceptual model development
  - Resource capacity estimates
  - Assessing risk to long-term production

Ohaaki, NZ

Suoh Depression, Sumatra

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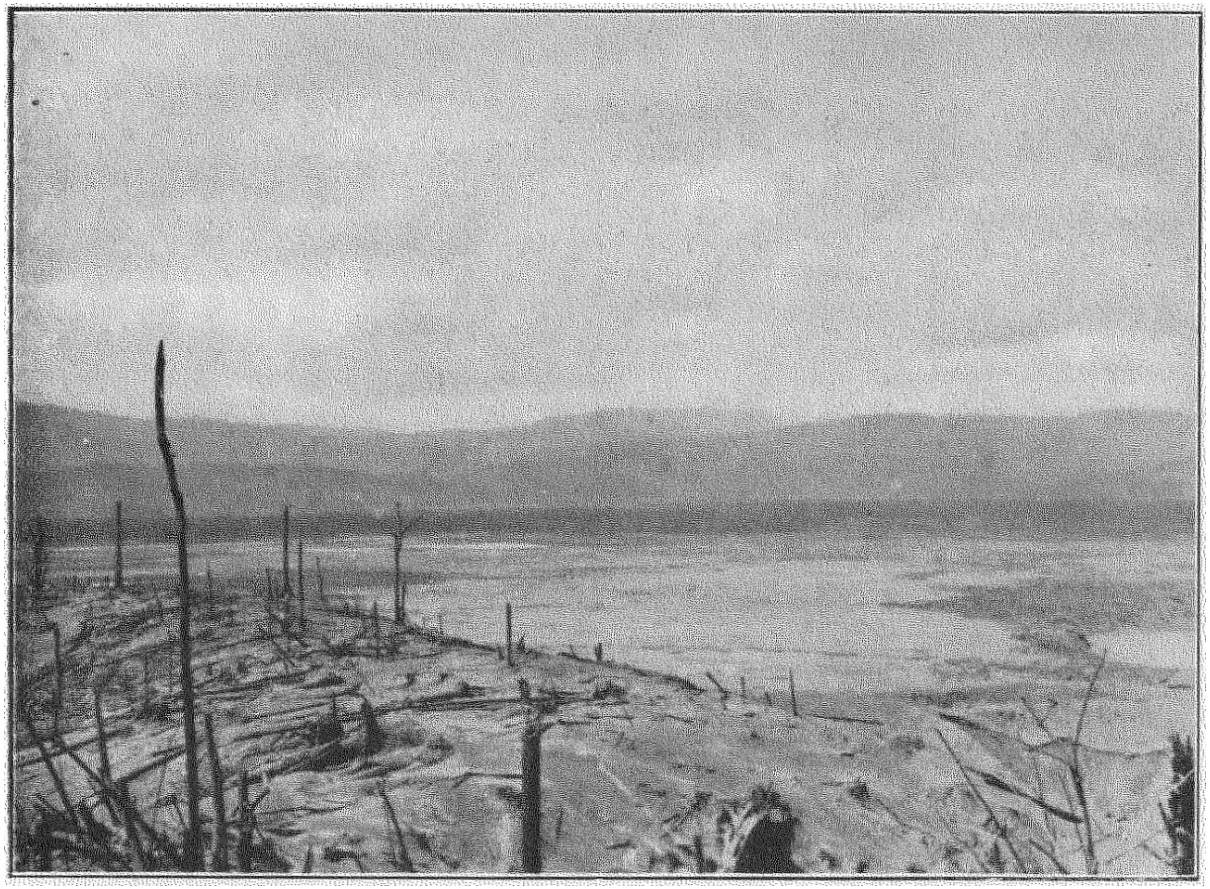
Resource Assessment



Suoh Depression, 1934

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Reservoir Management

Close cooperation between all disciplines is essential. The conceptual model must be continually updated, to guide reservoir management and to track:

- Pressure-drawdown
- Groundwater incursion
- Injection returns
- Steam-zone development
- Gas load
- Acid fluids
- Scaling

San Jacinto, Nicaragua. 72 MWe

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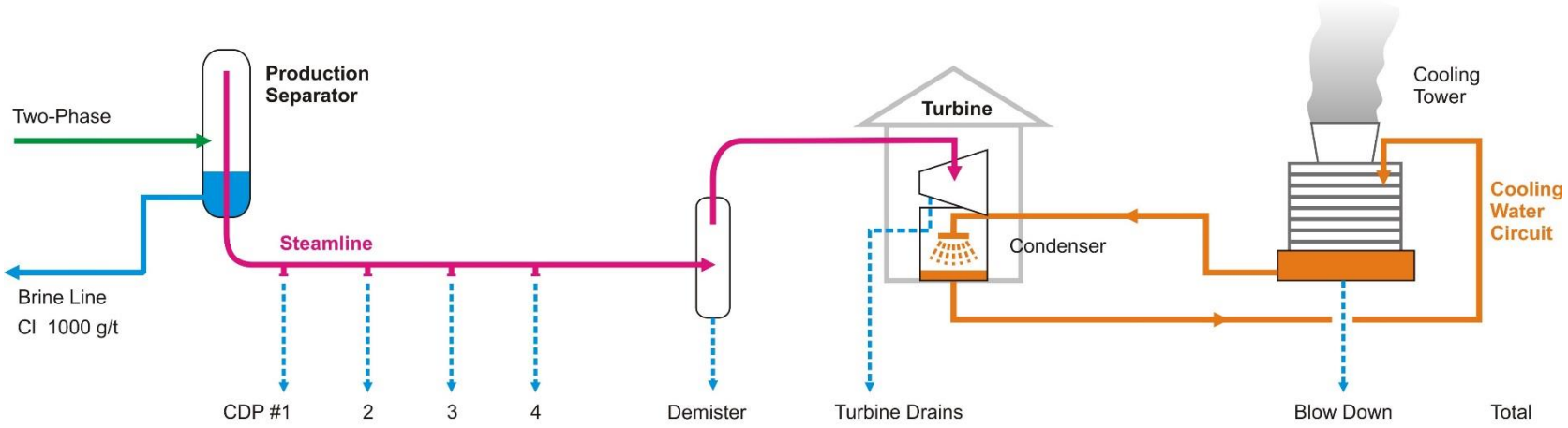
Steam Purity

- The whole steam separation system should be tested.
- Accurate steam purity sampling at turbine is futile. Better to track solids removal through separation system and into CW circuit.
- Provide access to sampling points at design stage.



Flow (t/h) =	0.1	0.2	0.2	0.2	0.5	5	20	
Chloride (g/t) =	500	100	20	10	8	0.1	0.5	
Cl Flow (g/h) =	**50**	20	**4**	**2**	**4**	**0.5**	**10**	**90.5 g/h**

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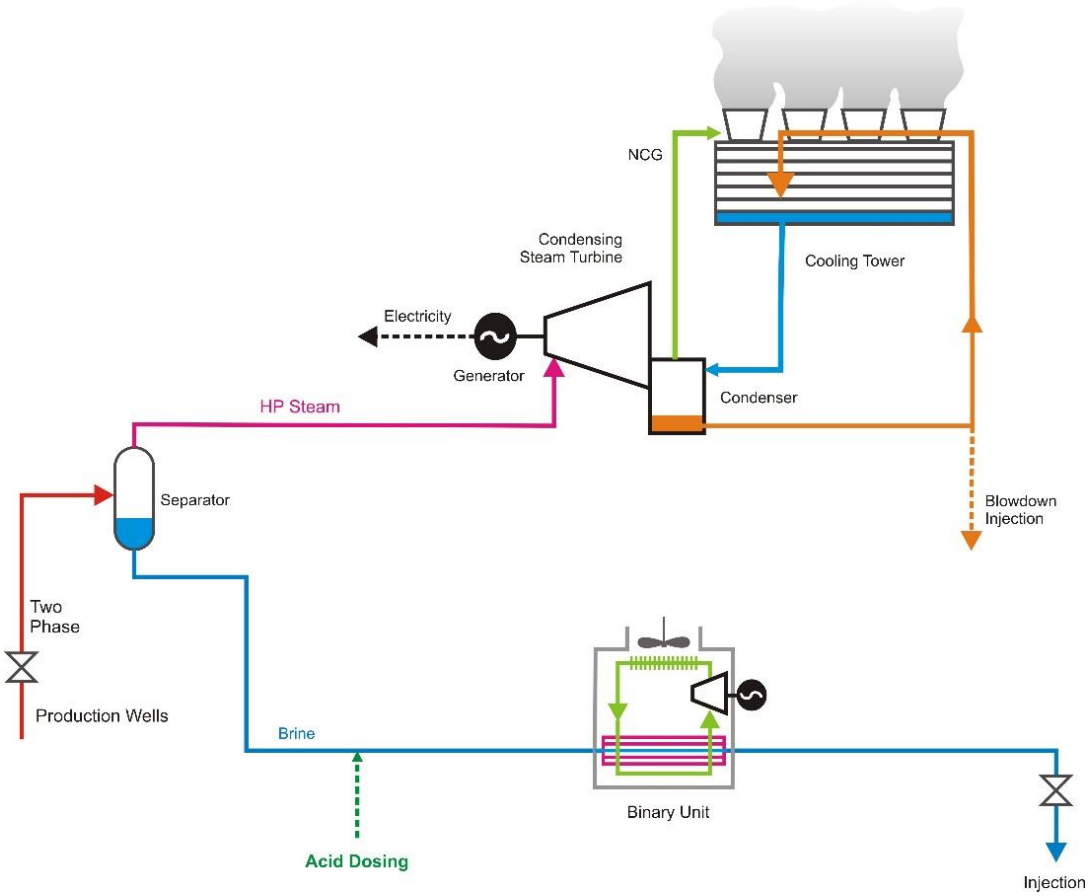
Silica Scale Control

- There is increasing interest in adding binary bottoming plants to older single-flash power stations, with acid dosing to avoid silica scaling. This presents a corrosion risk to the plant (if dosing upstream) and increases risk of sulphide scaling.



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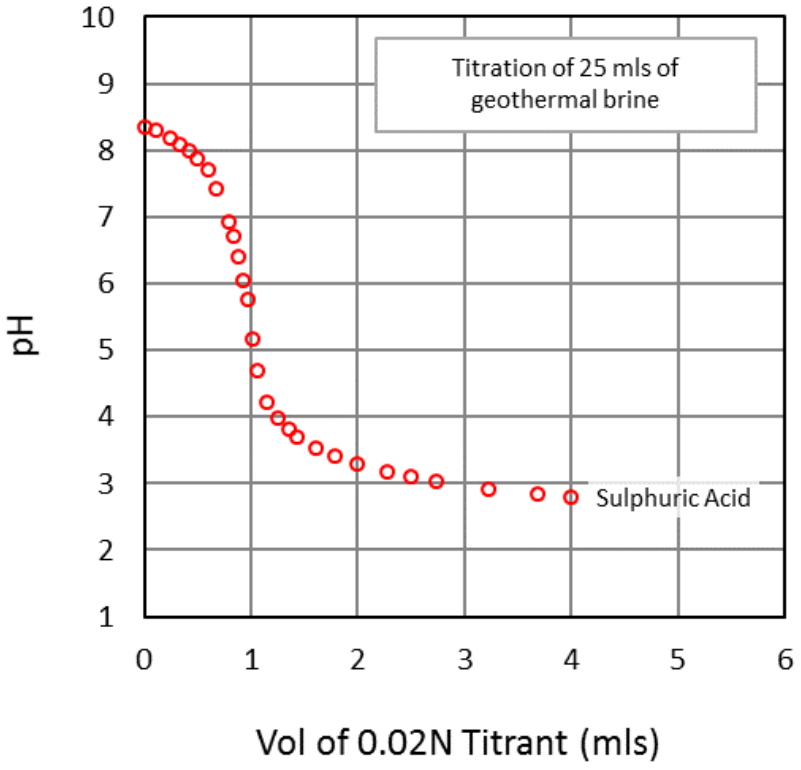
Silica Scale Control

- Maintaining a stable pH 5 with sulphuric acid is challenging and requires sophisticated process control.



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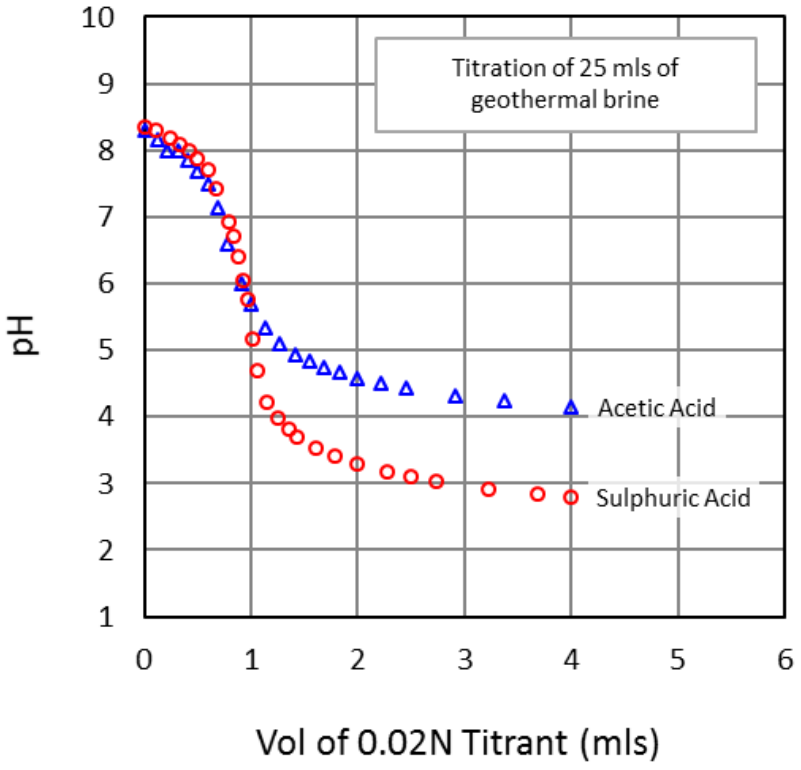
Weak Acid Dosing

- Acetic acid provides better pH control. Good where brine flow is variable or where critical plant is exposed to acid (e.g. binary plant).
- A 300 t/h brine line at San Jacinto has been dosed with acetic acid for past 18 months.



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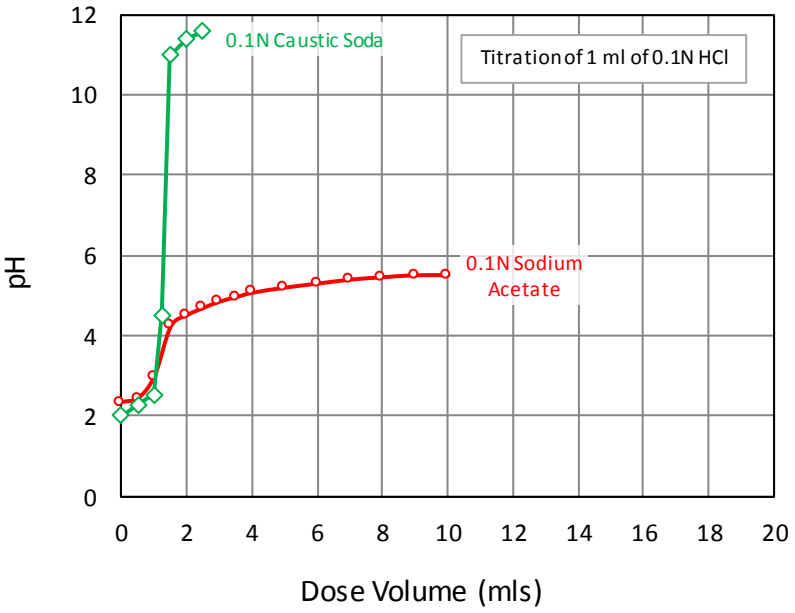
Weak Base Dosing

- Similar approach can be used to treat acid wells, including steam wells with HCl.
- Injecting weak bases may provide a safer method of managing these wells, compared to caustic soda. It reduces risk of calcite scaling.



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Thanks

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