DOCKETED	
Docket Number:	24-OIIP-02
Project Title:	Informational Proceeding on Lithium Valley Vision
TN #:	262111
Document Title:	Presentation Slide - Eva Schill
Description:	N/A
Filer:	Erik Stokes
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	3/6/2025 5:48:03 AM
Docketed Date:	3/6/2025

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The Lithium Valley Project

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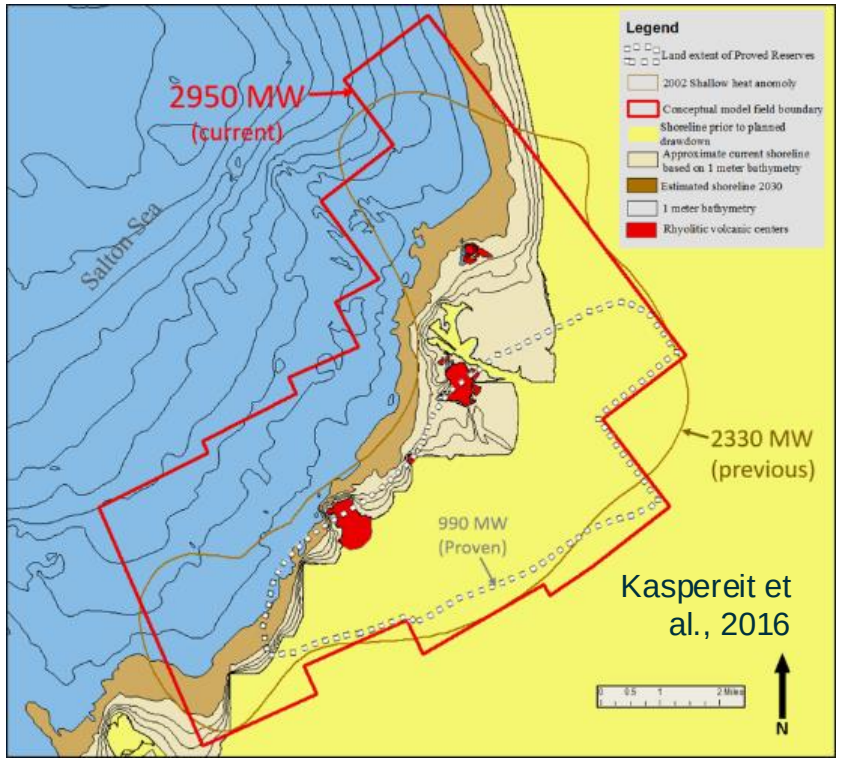
Stanford Geothermal Workshop – February 10-12, 2025

Lithium resource in the Salton Sea geothermal field

- Geothermal brine production:
  > 120 million metric tons per year
- Lithium brine concentration: 198 ppm
- **Lithium carbonate equivalent (LCE): about 127,000 metric tons per year**
- Total dissolved lithium:
  about 4.1 million metric tons of LCE
- Adjusting assumptions for porosity and total reservoir size (Kaspereit et al., 2016), the total estimated resource could rise to **as much as 18 million metric tons of LCE** (Dobson et al., 2023).

- Proven and probable resource extent of Salton Sea geothermal field

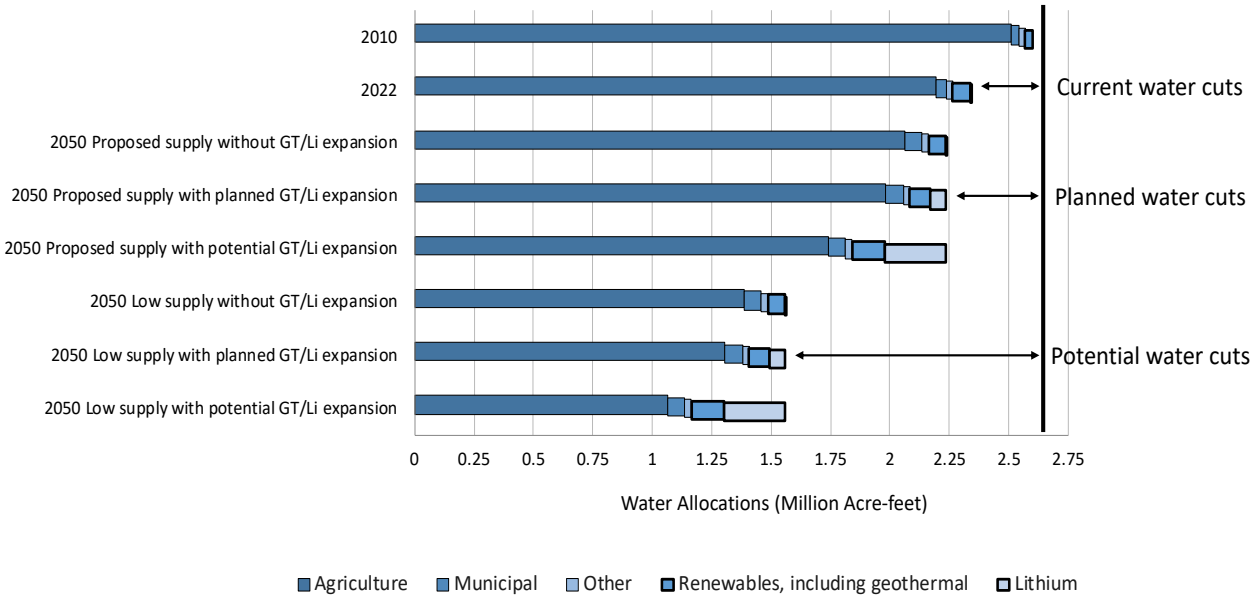


Planned, but suspended extension of geothermal production in the Salton Sea geothermal field

- Current production from the Salton Sea geothermal field
  - BHER net capacity of 345 Mwel
  - Cyrq net capacity of 50 MWel
- Planned increase of geothermal power production in the Salton Sea geothermal field.
  - Black Rock Geothermal Project:
    designed for a gross capacity of 87 MWel and a net capacity of 77MWel
  - Elmore North Geothermal Project:
    designed for a gross capacity of 157 MWel and a net capacity of 140 MWel
  - Morton Bay Geothermal Project:
    designed for a gross capacity of 157 MWel and a net capacity of 140 MWel

Water consumption including energy and direct Li extraction (DLE)

- DLE requires 3.5-4 times the water of geothermal energy production



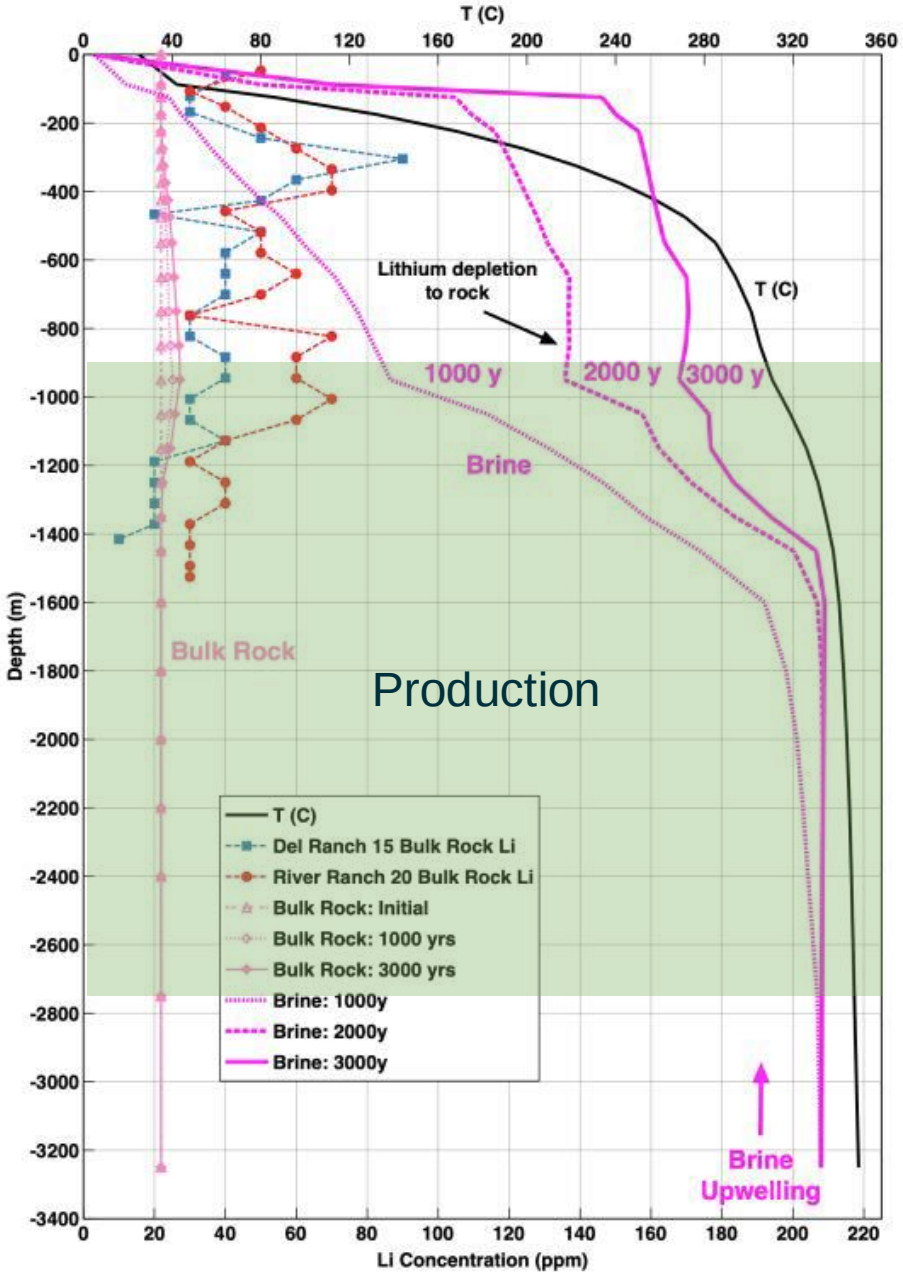
Geothermal Facility	Energy Output	Water Use m^3/MW	Percentage of steam condensate generated
Salton Sea geothermal field Average		493 – 39,471 Ø = 19,736	
Morton Bay Geothermal	140 MW	48,981	50%
Black Rock Geothermal	77 MW	18,021	80%
Elmore North Geothermal	140 MW	57,084	50%
Hell's Kitchen Power Co	49.9 MW	4,946	No Data

Solid waste from energy production

Wastes (metric tonnes/yr)	Black Rock	Elmore North	Morton Bay
Non-hazardous process waste: non-hazardous geothermal filter cake	13,000	22,000	22,000
Hazardous process waste: Brine pond solids, geothermal scale, hazardous geothermal filter cake, cooling tower debris and sludge	10,000	11,000	11,000
Hazardous waste: Petroleum contaminated solids, oily sludge, and used oil	110	120	120
Nonhazardous: Commercial trash	68	110	110
Misc. hazardous and universal waste: Aerosol containers, solvents, paint, adhesives, laboratory analysis waste, lead acid batteries, alkaline batteries, fluorescent tubes, scrap metals, electronic waste	<2	<3	<3

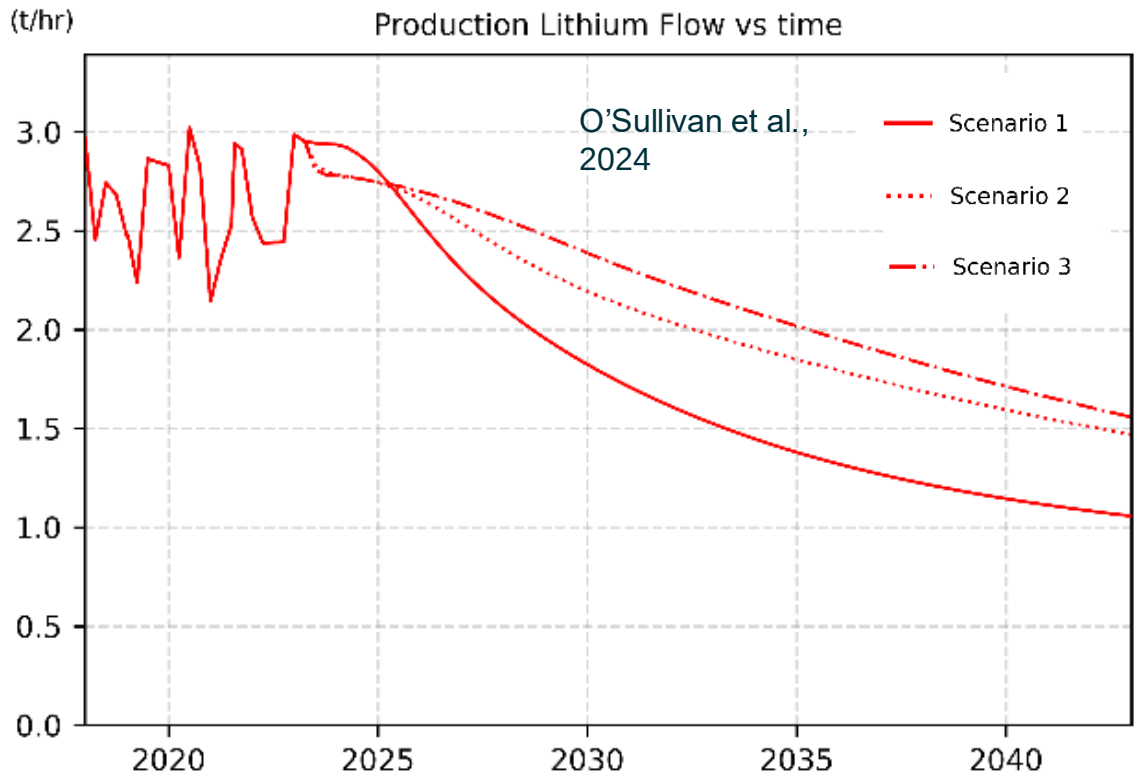
Lithium evolution and reservoir reactive-transport modeling

- Li-rich smectite (hectorite) forms at lower temperatur slightly higher temperatures.
- Although dissolution of Li-bearing albite and K-feldsp formation, most Li is derived from the hot upwelling l
- Li is extracted from brine into minerals above 1200 r



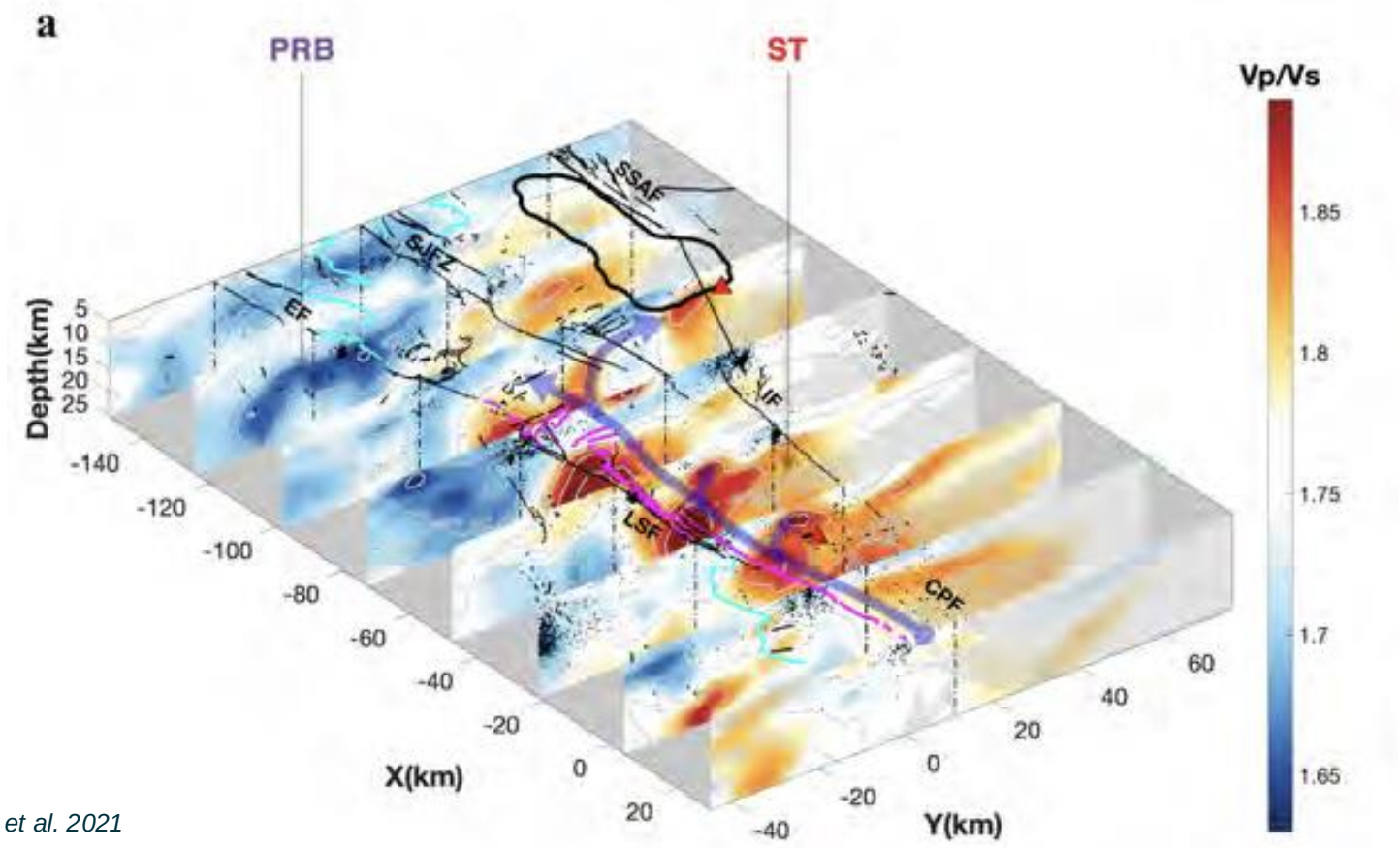
Lithium production over time at 95% of lithium removal from brine

- Scenario 1: current layout of injection
- Scenario 2 and 3:
  - The total amount of reinjected fluid was kept constant
  - A total of 36 new reinjection wells were planned: 18 to intermediate depths and 18 to the deep reservoir
- Scenario 2: the total reinjection split evenly (360 tons/h in each well)
- Scenario 3: 600 tons/h in deep wells and 120 t/h in intermediate wells to slow down the thermal breakthrough

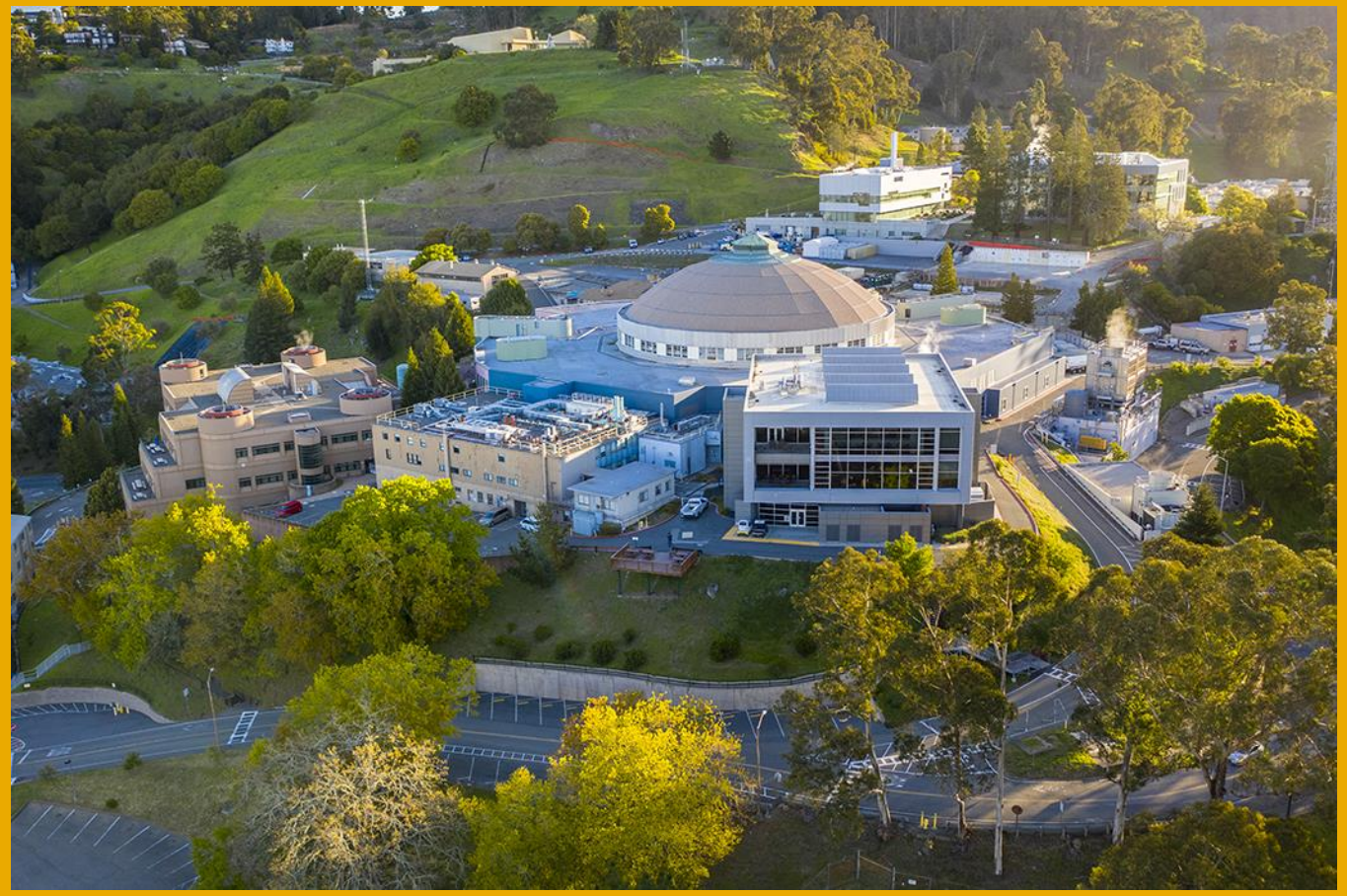


- **Lithium decline rates vary depending on chemical breakthrough from nearby wells.**
- **Model suggests 30% lithium production increase for Scenario 3 vs. Scenario 1 over 19 years of production.**

Indication for geothermal resources along the western shore of the Salton Sea



Share et al. 2021



Thank You

This work is supported by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (EERE), Geothermal Technologies Office, under Award Number DE-AC02–05CH11231 to Lawrence Berkeley National Laboratory

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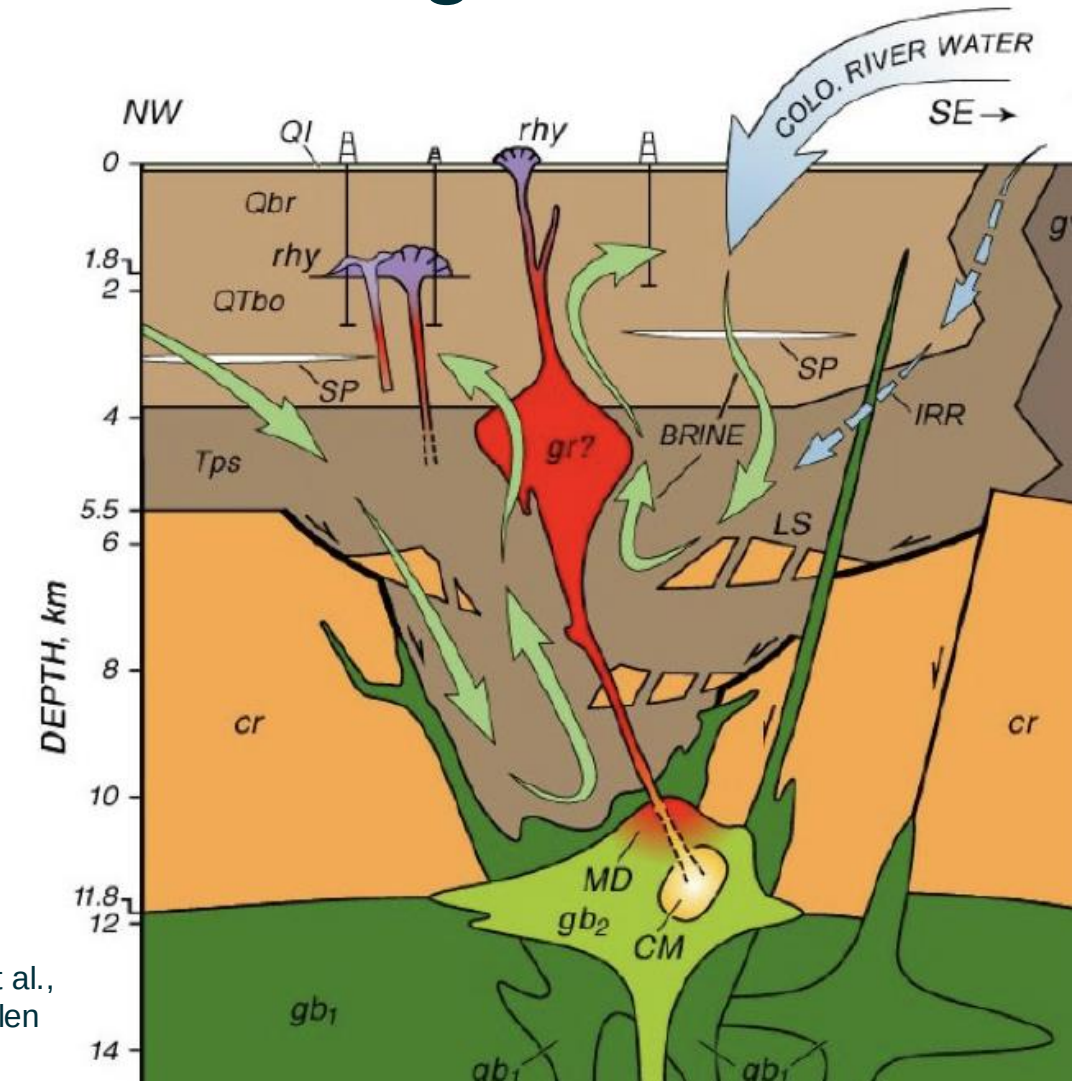
The source of lithium in the Salton Sea geothermal field

- Primary sources of Li: salt-rich pore fluids and clay-evaporite deposits from repeated flooding of the Imperial Valley by the Colorado River (Pleistocene epoch, Humphreys et al., 2023)
- Primary source of geothermal brine: burial of these lacustrine-evaporite sediments and pore fluids (Williams and McKibben, 1989; McKibben et al., 1988).



Humphreys et al., 2023 after Hulen et al., 2002

Water consumption during production

- Building bottom-up model of water use
  - Grounding in current industry practice and sound technical principles
  - Data sources: past and updated Environmental Impact Reports, industry responses to data requests, scientific literature, fundamental engineering principles, and patents

New facility data

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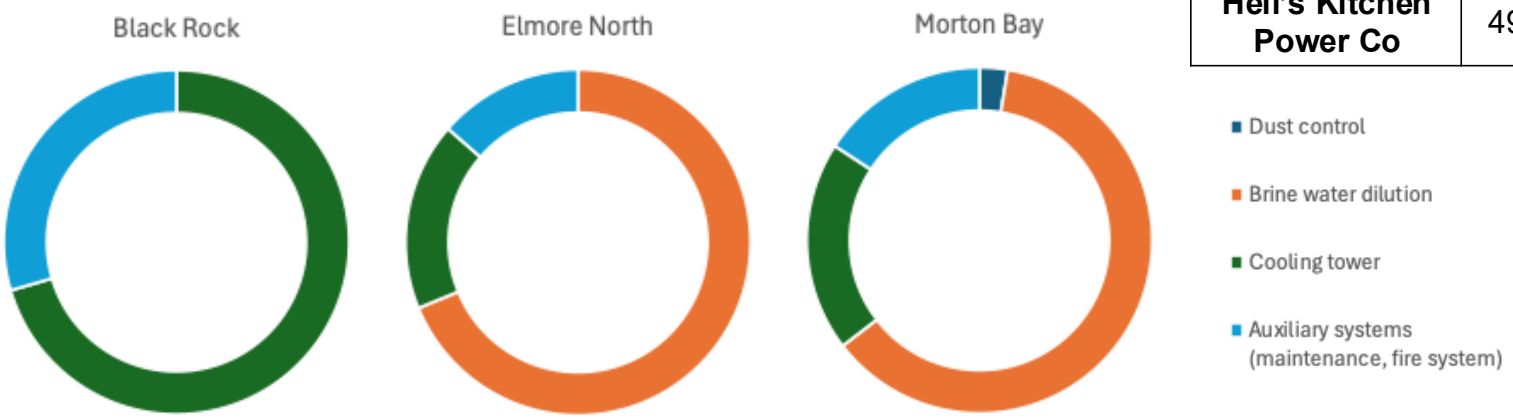

Water demand for geothermal and lithium recovery

Geothermal power production

- Cooling towers
- Brine water dilution to prevent scaling
- Steam condensate: 50-80% in new facilities
- Water use varies by plant

DLE

- Washing and stripping to remove lithium from the sorbent
- Could be reduced through water recycling