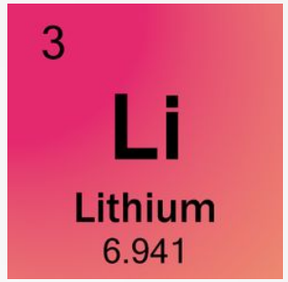
# A Review of Lithium as a Critical Industrial Material and Engagement Prospects in New Mexico




**Mark R. Leo-Russell**
**Virginia T. McLemore**

**New Mexico Bureau of Geology and Mineral Resources**
Mark.Leo-Russell@nmt.edu, Virginia.McLemore@nmt.edu

# Acknowledgements

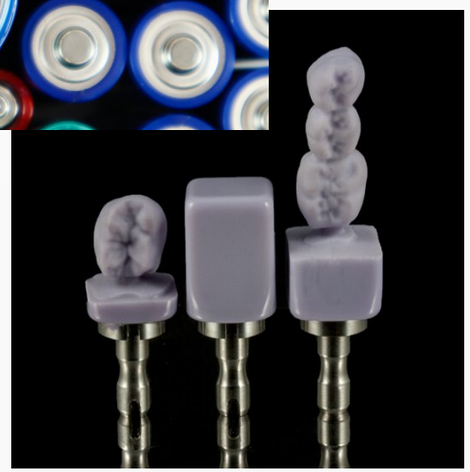

- This presentation is part of ongoing studies of mineral resources in New Mexico, supported by the New Mexico Bureau of Geology and Mineral Resources (NMBGMR), Nelia Dunbar, Director and State Geologist. These studies were partially funded by the U.S. Geological Survey NGGDP Data preservation Cooperative Agreement No. G22AS00033 and G21AP10434.
- Thanks to the student and staff members of the Bureau's Economic Geology Team for all their hard work and contributions to geology research in New Mexico. The first author would also like to acknowledge David Kasefang, Information Systems Team Lead at the Bureau of Geology, who lets me get away from our databases from time to time to do field work.

# Introduction & Overview

- Introduction & Overview
- Lithium Elemental Properties
- Lithium the Commodity
  - Production History and Market Value
- Lithium Deposits
  - Pegmatites
  - Volcanic Clays
  - Brines, Evaporates and Geothermal Fluids
- Lithium in New Mexico
  - History and Prospects
  - Current Research and Exploration
- Review & Summary

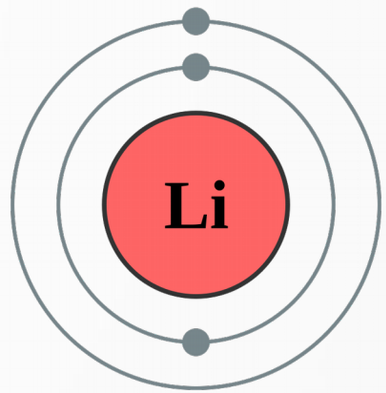
# Lithium Uses and Applications

- Lithium, a critical mineral as defined by the USGS, is widely used in lubricants, medicines, metal alloys, ceramics, glass, and most commonly, batteries.

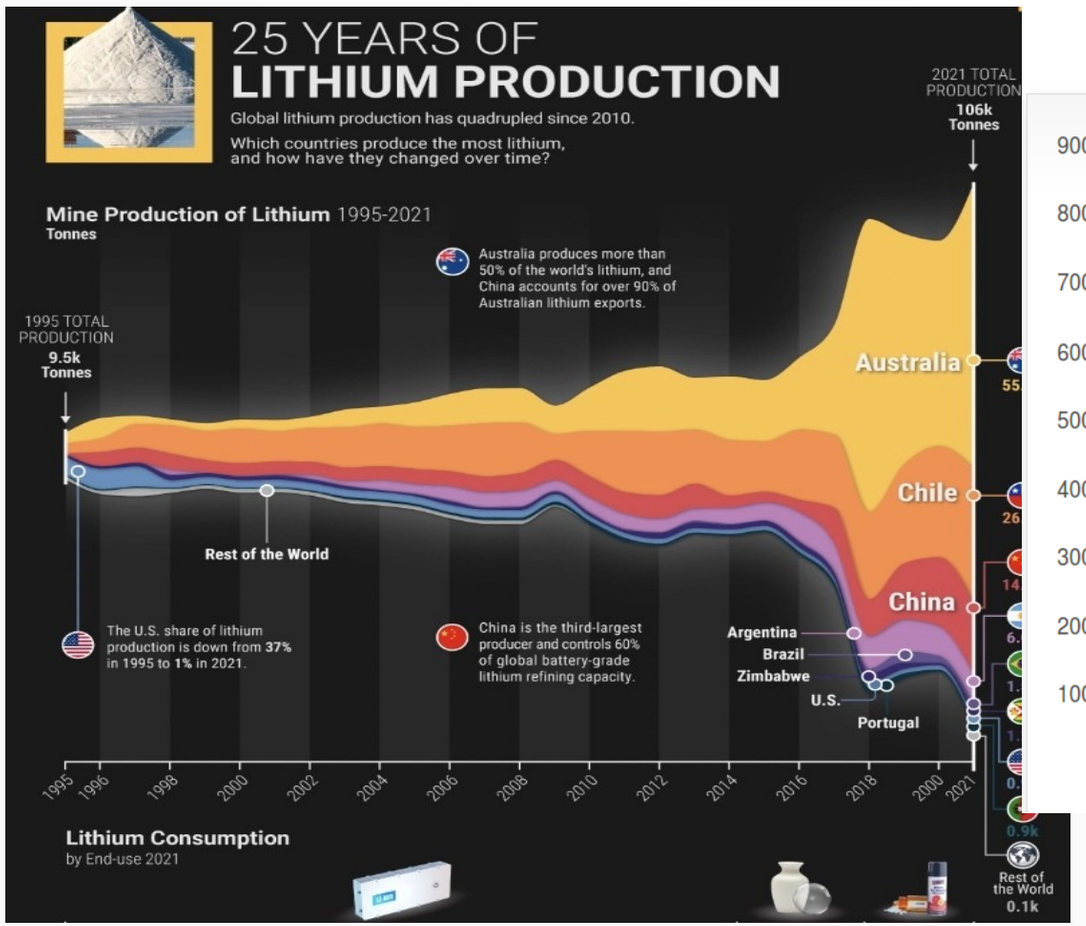
# Lithium Elemental Properties

- **What is it about Lithium that makes it such a versatile material?**
  - Lightest of all metals
    - Atomic number: 3
    - Atomic weight: 6.942
  - Two stable isotopes with lowest of binding energies
    - $^{7}Li$ 95.15% of natural abundance
      Primordial nuclide - Big Bang nucleosynthesis
    - $^{6}Li$ 4.85%
  - Single electron in valence shell makes Li very reactive – must be stored away from air and water
    - electron configuration: $1s^2 2s^1$
  - Reactivity gives it good thermal and electrical conductivity – key properties for use in batteries

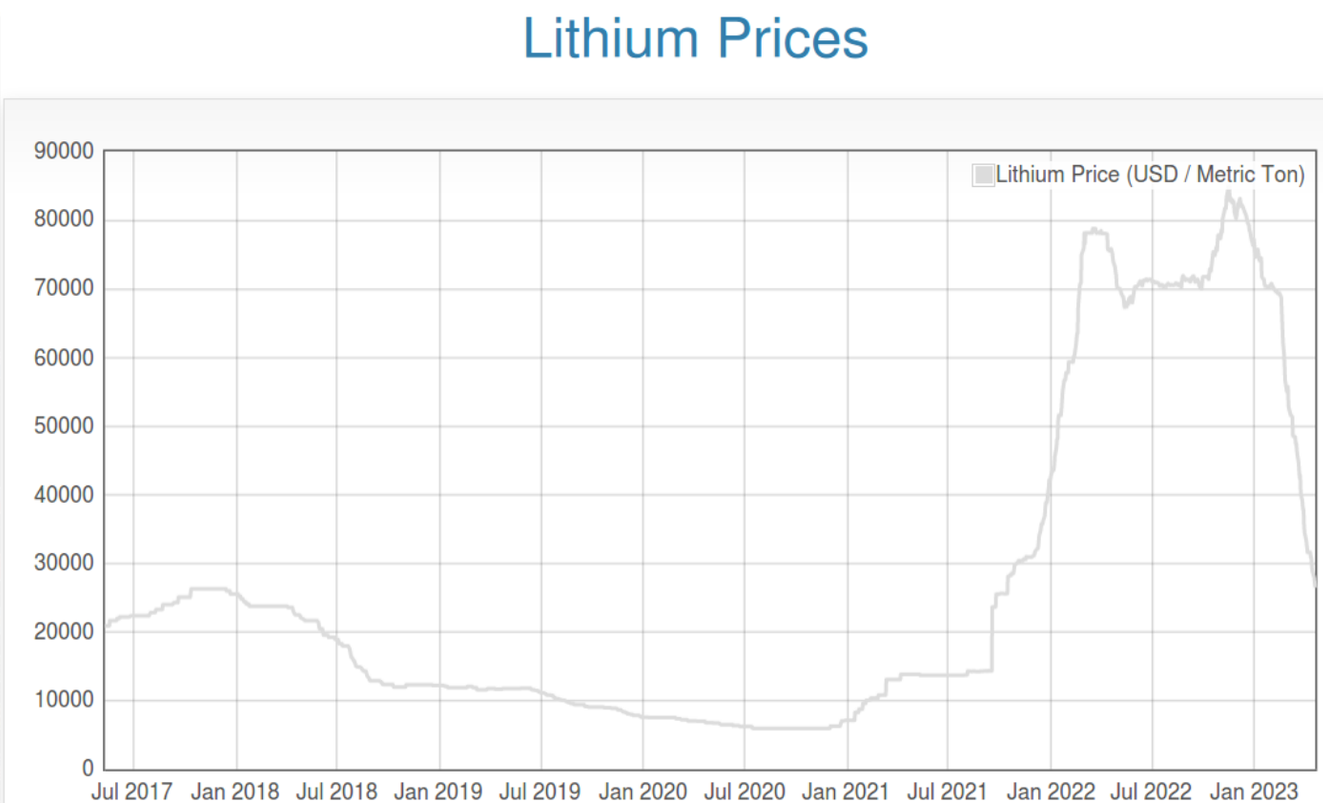



# Lithium the Commodity

- **Lithium Production and Market History**




World Economic Forum, https://www.weforum.org/agenda/2023/01/chart-countries-produce-lithium-world/




Daily Metal Prices, https://www.dailymetalprice.com/metalpricecharts.php

# Lithium Deposits

- **Economically-viable Lithium deposits**
  - Pegmatites
  - Volcanic clays
  - Brines including evaporates, playas and subsurface fluids from petroleum and geothermal production

Lithium is extracted from salars in South America's *Lithium Triangle*-- Argentina, Bolivia and Chile

# Lithium Deposits: Pegmatites

- Pegmatites are the most common hard rock source of Lithium
  - Minerals
    - Spodumene
      $LiAlSi_2O_6$
    - Lepidolite
      $K(Li,Al)_3(Si,Al)_4O_{10}(F,OH)_2$

Harding Pegmatite Mine, Taos County, New Mexico

Spodumene, Newry Mica Mine, Oxford Co., Maine



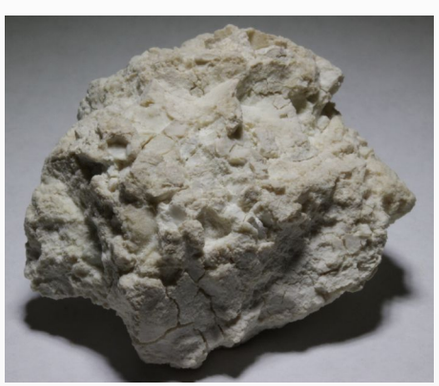
Lepidolite on Quartz, Harding Pegmatite Mine

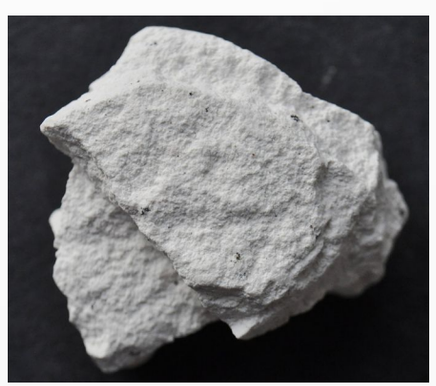
# Lithium Deposits: Volcanic Clays

- Volcanic clays are another important type of Lithium deposit
  - Minerals
    - Hectorite

      $Na_{0.33}(Mg,Li)_3Si_4O_{10}(F,OH)_2$
    - Montmorillonite

      $(Na,Ca)_{0.33}(Al,Mg)_2(Si_4O_{10})(OH)_2 \cdot nH_2O$
    - Bentonite

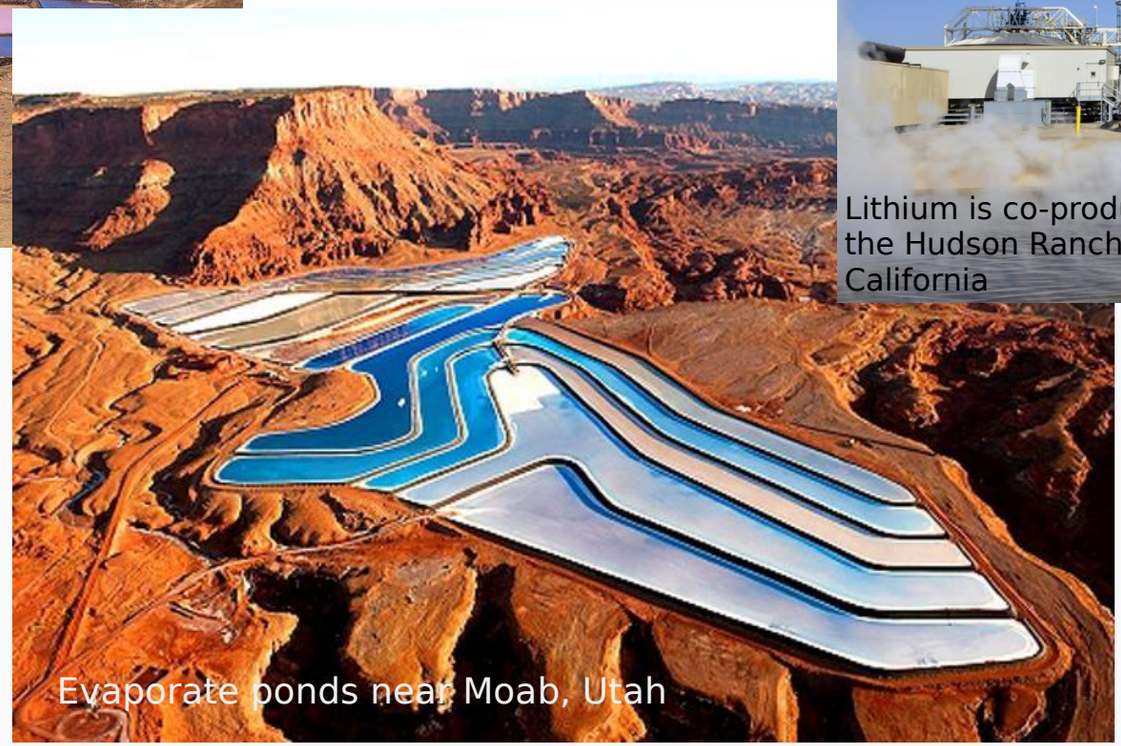





# Lithium Deposits: Brines & Evaporates

- Brines, Evaporates and Geothermal Fluids are leading sources of Lithium

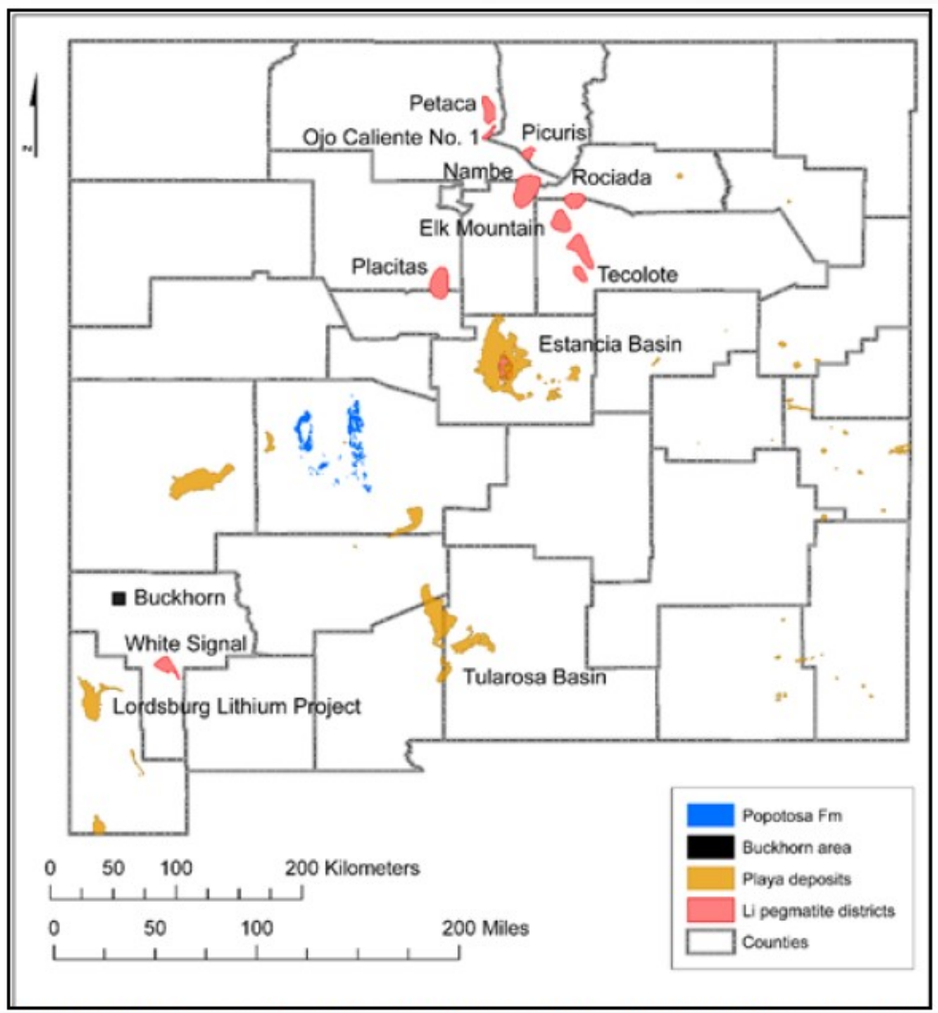
Evaporate ponds near Yaiza, Lanzarote, Spain


Evaporate ponds near Moab, Utah


Lithium is co-produced with geothermal energy at the Hudson Ranch power plant, Salton Sea, California

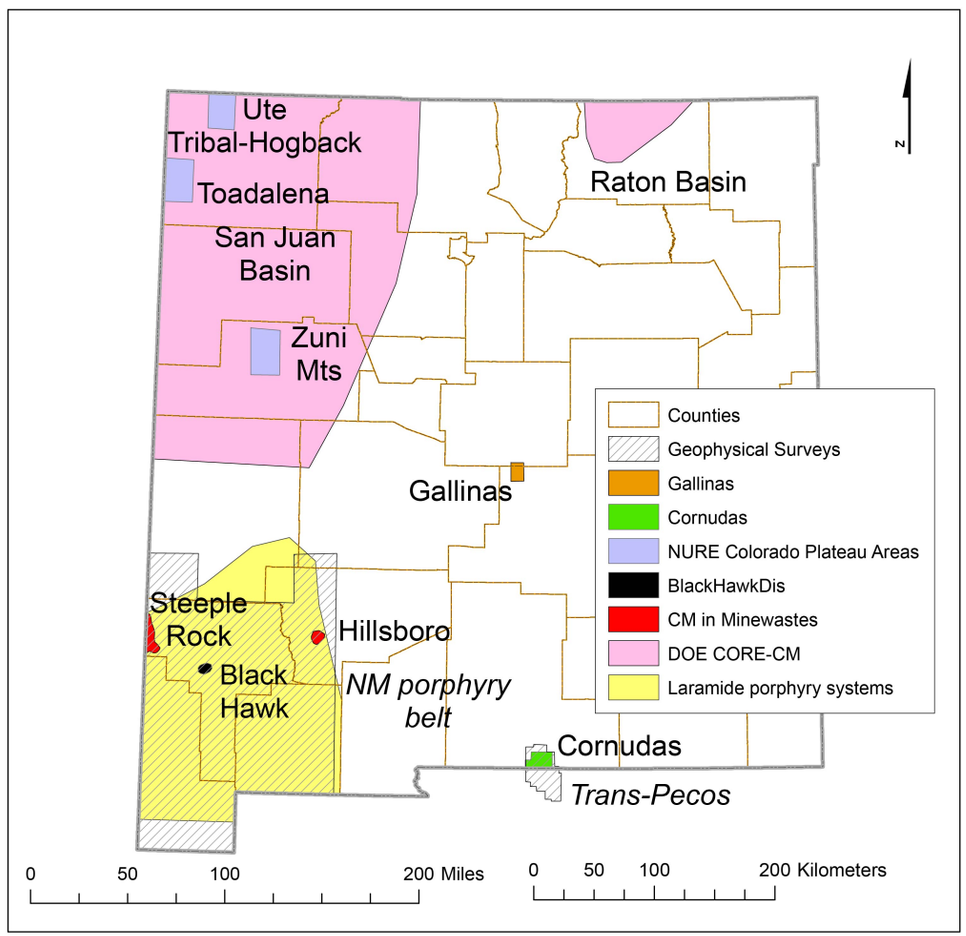
# Lithium in New Mexico

- New Mexico accounted for 10% of US production from 1920 to 1950, mostly from the Harding Pegmatite Mine in Taos County
- No Lithium produced in NM since then
- Current prospects:
  - Pegmatites in northern NM
    - not likely to be developed anytime soon for various economic and political reasons
  - Volcanic clays
    - Popotosa Formation in the Rio Grande Rift
      ↳up to 3800 ppm Li
  - Diatomite and Zeolites
    - Gila Formation (Buckhorn deposit) near Silver City
      ↳14 to 200 ppm Li
  - Brine and Hydrothermal/Geothermal
    - Lordsburg, Tularosa and Estancia Basins
      ↳124 ppm Li ↳up to 624 ppm Li



# Lithium in New Mexico

- Numerous projects underway at NMBGMR, NMT and elsewhere researching critical minerals in New Mexico including Lithium
  - Porphyry deposits
  - Carbonatites
  - Mine Wastes
  - Coal, coal wastes and related materials (humates)
  - Subsurface fluids



# Review & Summary

- Introduction & Overview
- Lithium Elemental Properties
- Lithium the Commodity
  - Production History and Market Value
- Lithium Deposits
  - Pegmatites
  - Volcanic Clays
  - Brines, Evaporates and Geothermal Fluids
- Lithium in New Mexico
  - History and Prospects
  - Current Research and Exploration

# Closing...

- Questions ??
- Comments ??

Thank You.

Information on this topic and our other projects are available on the New Mexico Bureau of Geology's website:
https://geoinfo.nmt.edu