

Gabriel Liu, The University of Texas at Austin, Austin, Texas, USA for their project: *Deep Learning Design and Directed Evolution of Biological Binders for Lithium Recovery*.

I am an MSc candidate in the Jackson School of Geosciences at the University of Texas at Austin, working under the supervision of Dr. Daniel Alessi. My research develops engineered proteins and peptides for selective lithium recovery from subsurface brines.

Oilfield produced waters and geothermal brines hold a large and largely unrecovered lithium resource, but their chemistry works against extraction. Lithium is dilute, while sodium, potassium, magnesium, and calcium are orders of magnitude more abundant, and dissolved organics and hydrogen sulfide degrade conventional sorbents. My project asks whether binding sites can instead be designed for the specific fluid they will encounter.

I use deep learning tools to generate diverse candidate lithium-binding scaffolds, then refine them experimentally. Designs are displayed on the yeast cell surface and screened by fluorescence-activated cell sorting for lithium-dependent signal, with selection stringency increased across synthetic brines that span realistic salinities and major-ion ratios. Enriched populations are sequenced, re-diversified, and re-screened, so that each round moves the population toward greater selectivity and brine tolerance. Top lineages are then evaluated for regeneration and reuse across repeated binding cycles.

With support from the Lipman Student Research Grant, I will fund surface display of these designed binders on yeast.

I earned an honors BSc in biochemistry from the University of Alberta before beginning my MSc at UT Austin. I am grateful to the Howard and Jean Lipman Foundation and the Geological Society of America for supporting my research.

