How to use the geologic record to understand Earth's climate future

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The western U.S. is an arid region. Yet geologic reconstructions of this region show evidence for vast lakes filling what are now dry valleys. Most recent studies suggest that these ancient lakes existed during the time spanning 18 to 15 thousand years ago, linking unusually wet conditions to the time when the last Ice Age was swiftly ending (the deglaciation). While this general correlation is robust, there are uncertainties in the precise age of this wet interval. Did this interval occur in a single year, or did it span hundreds or thousands of years? This uncertainty frustrates our understandings of what underpins water availability in the western U.S.

To circumvent those uncertainties, I employed the uranium-series geochronometer to date near-shoreline carbonates at Mono Lake in east-central California. The resultant ages, when combined with careful field observations of the geomorphic and sedimentary records in the Mono Basin, compose a century-scale time series from 20,000 to 15,000 years ago. This time series shows the rise of the lake to its high stand. While the results are consistent with prior studies that correlate regional wetness to the last deglaciation, the precision of the uranium-series ages now permits the correlation of Mono Lake's high stand to abrupt climate events that occurred about 16,000 years ago. There is no consensus on the source of the abrupt change in climate 16,000 years ago, but most fingers point to a short-lived but massive flux of ice and meltwater into the North Atlantic from the Laurentide Ice Sheet. Could this extreme but transient discharge of ice and meltwater be the precise cause for the dramatic wetting that lifted Mono Lake to levels higher than any attained in tens of thousands of years?

Guleed Ali is an IDEA Fellow of the Department of Geosciences. Guleed studies how water availability changed during past intervals of global warming. To reveal these changes in past hydroclimate, he reconstructs the evolution of landscapes and pairs these data with absolute dating methods to determine the ages, rates, and sizes of change. Guleed focuses on the hydroclimatic records of the western United States. This work shows how regional wetness fluctuated during the last Ice Age and reveals new connections between this water-stressed region and Earth's energy balance.

Guleed's desire as an IDEA fellow is to do a wider, deeper exploration of the geologic record to develop better insights into our climate future.