Here we present a high-resolution climate record from an 82-m lacustrine sediment core (VC-3) from the Valles Caldera (Fig. 1) that spans two mid-Pleistocene glacial cycles from MIS 14 to MIS 10 (Valle Grande, Pajarito Plateau, New Mexico, USA). The core is located within a large volcanic caldera that has experienced extensive tectonic uplift, which may have been particularly pronounced during the last 400 kyr. The caldera is aligned along a major extensional fault system, the Saltillo Fault Zone, which has been active since the last interglacial (MIS 5e).

Our climate record is based on a suite of proxy indicators, including the frequency of tephra layers, stable isotope compositions of oxygen and carbon in the mineral illite, and organic carbon content. These proxies provide a detailed record of climate variability over the past 1.5 million years. The record shows that the southwestern United States (US) experienced a series of warm, dry intervals (megadroughts) during the mid-Pleistocene, with periods of extended warmth and aridity lasting centuries to millennia. These intervals indicate a significant reduction in summer precipitation and aridity, which is consistent with the broad-scale pattern of increased aridity in the US during mid-Pleistocene interglacials.

Using molecular paleo-aridity proxies, we were able to track changes in plant communities during these warm, dry intervals. The record shows that periods of extended warmth and aridity were associated with a shift from wetland and forest communities to more xeric plant communities, including grasses and shrubs. These changes are consistent with the broad-scale pattern of increased aridity in the US during mid-Pleistocene interglacials.

The potential for increased drought frequency and severity linked to anthropogenic climate change in the semi-arid regions of the southwestern US is a serious concern. Understanding the causes of past megadroughts in the southwestern US can provide insights into the potential impacts of future climate change. Our results suggest that the southwestern US experienced a series of megadroughts during the mid-Pleistocene, with periods of extended warmth and aridity lasting centuries to millennia. These intervals are consistent with the broad-scale pattern of increased aridity in the US during mid-Pleistocene interglacials.

In summary, our high-resolution climate record from the Valles Caldera provides new insights into the causes of past megadroughts in the southwestern US. The record shows that the southwestern US experienced a series of warm, dry intervals during the mid-Pleistocene, with periods of extended warmth and aridity lasting centuries to millennia. These intervals are consistent with the broad-scale pattern of increased aridity in the US during mid-Pleistocene interglacials.