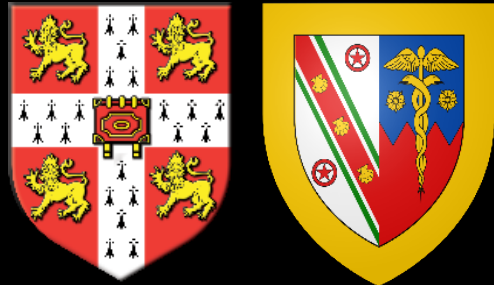




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A paleoclimatic perspective of triple oxygen isotopes from gypsum in Holocene Thar Desert playa lakes



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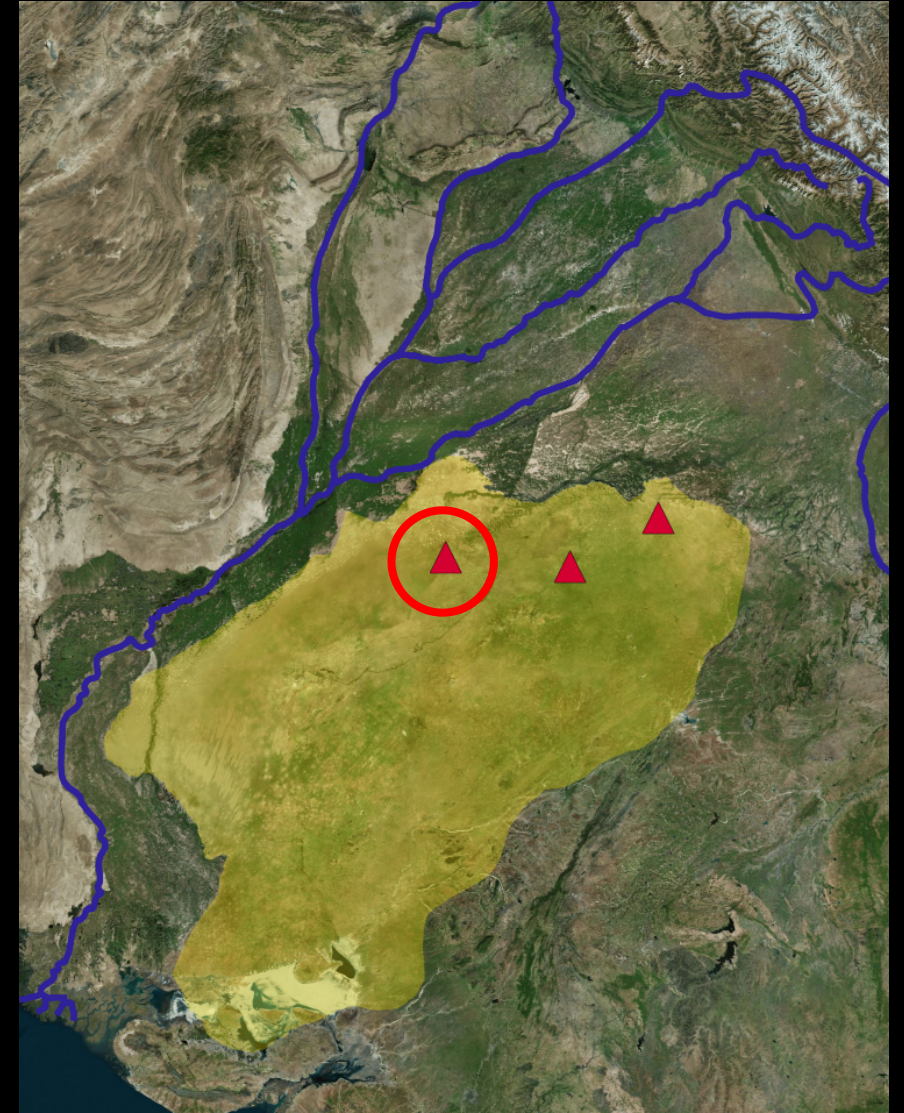
*Study sites located in
Thar Desert, NW India*

*Today we focus on three playa lake
deposits from this area:
Khajuwala, Lunkaransar, and Karsandi*



Khajuwala – a previously unstudied site, now a gypsum mine!

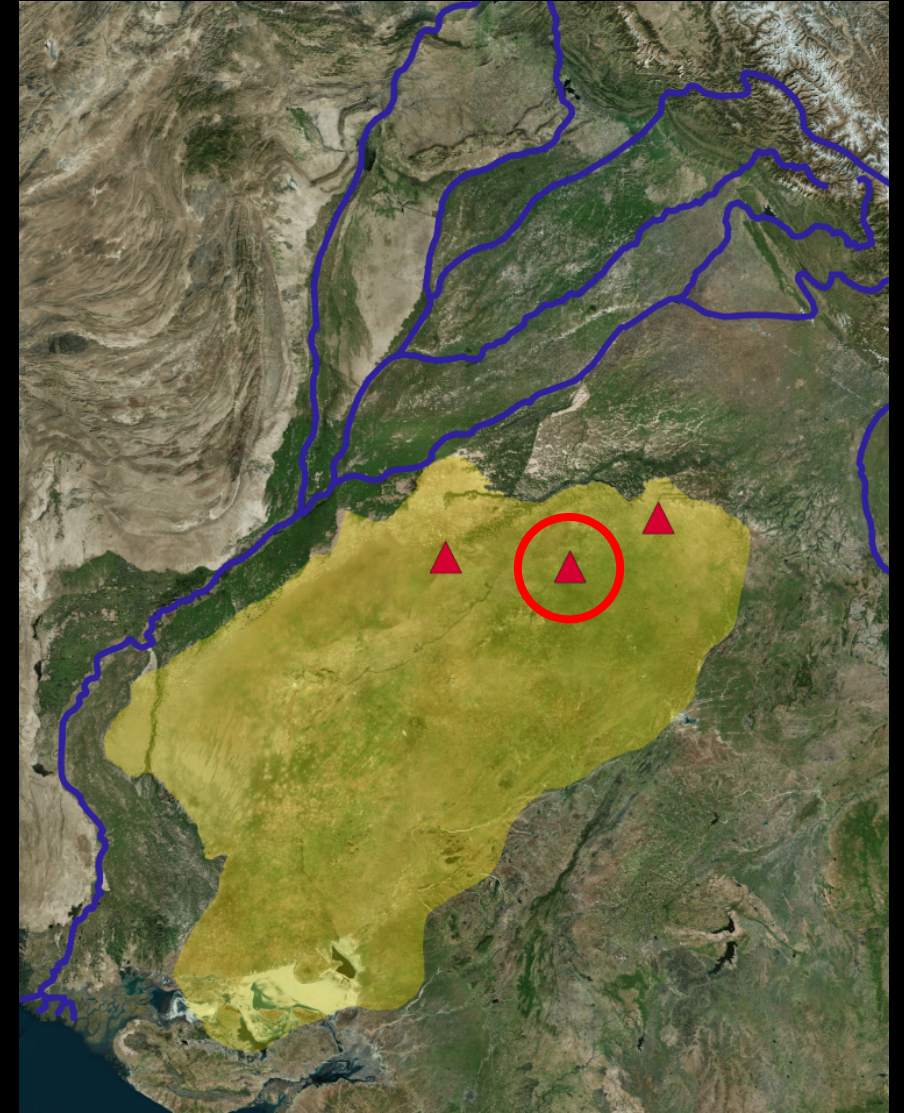
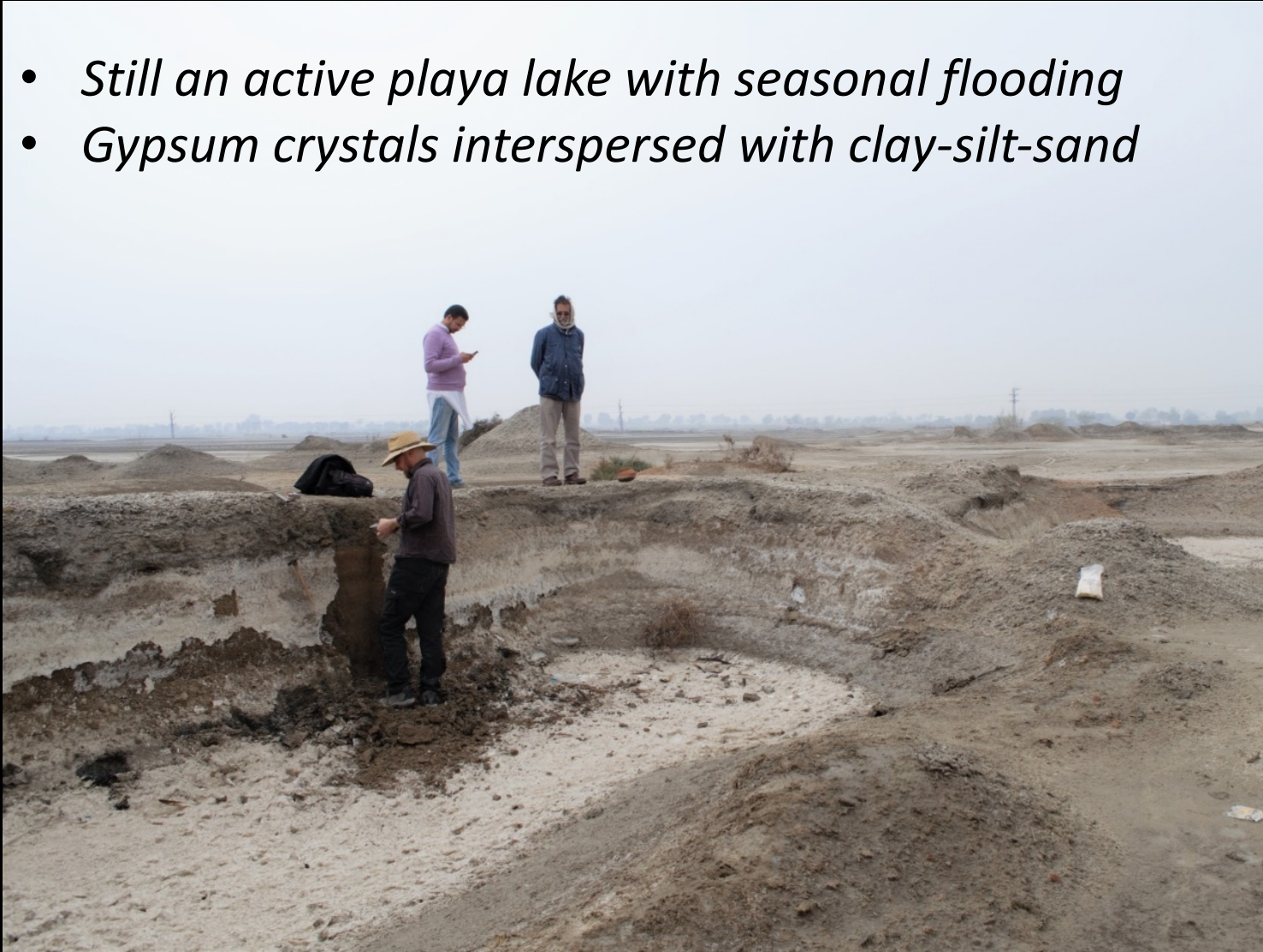
- Deposits here are >70% gypsum
- Dates are up to 12 ka BP, but deposition was discontinuous



Lunkaransar

Also investigated by Singh et al., 1974; Enzel et al., 1999

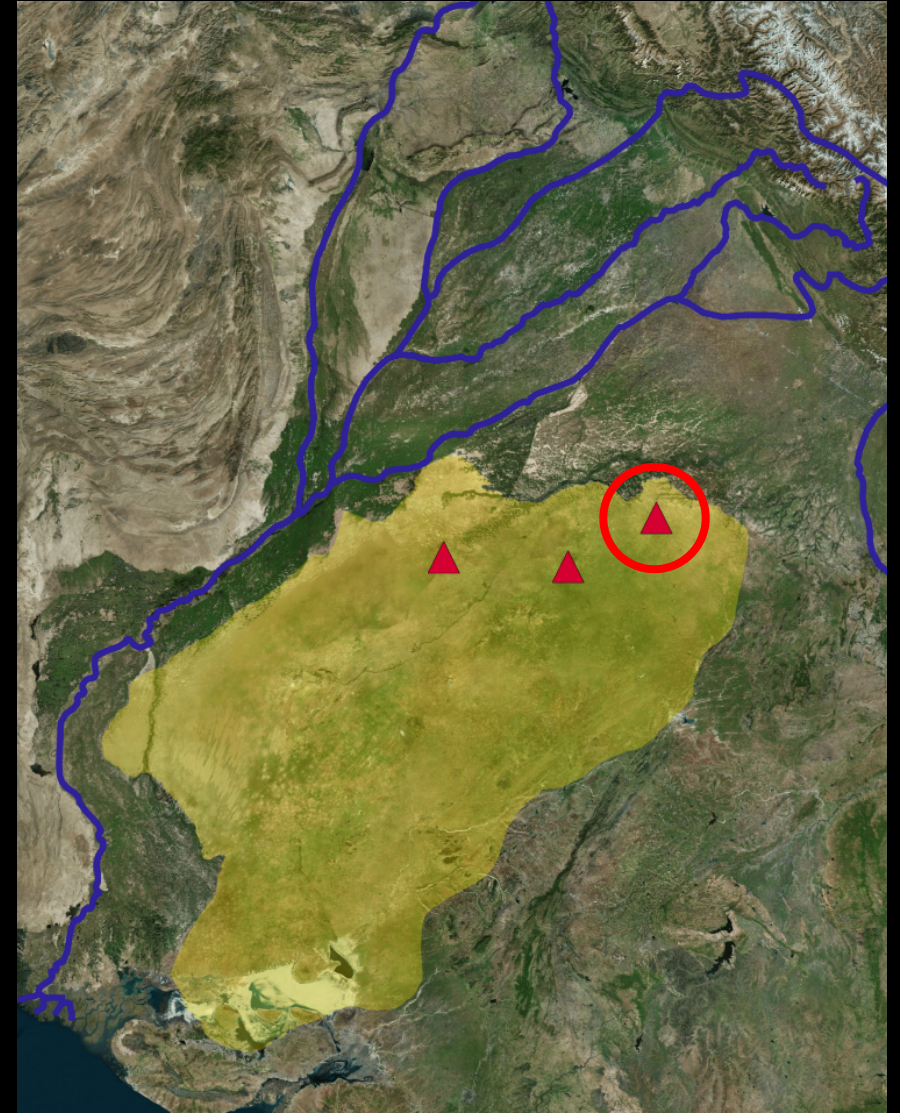
- *Still an active playa lake with seasonal flooding*
- *Gypsum crystals interspersed with clay-silt-sand*



Karsandi

Also investigated by Saini et al., 2005; Dixit et al., 2018

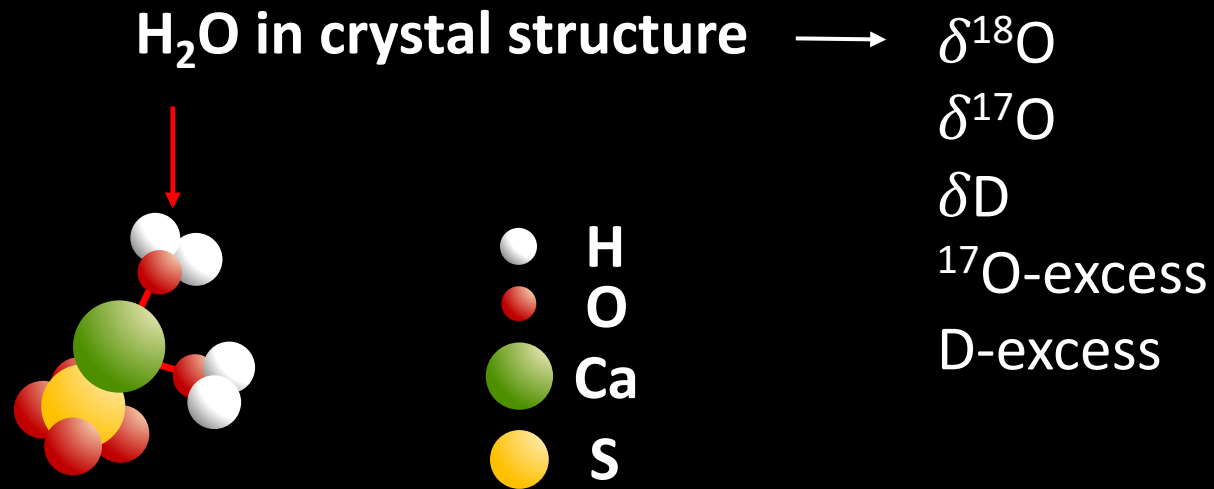
- Dry deposit, like Khajuwala
- Ages cover c. 12-4 ka BP



Water isotopes in gypsum: what do they tell us?

Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is a hydrated mineral containing 20.9% water by weight!

*The isotope signal gets “locked in” after gypsum is formed in the playa lake...
In theory, no exchange should occur thereafter. The lake signal is preserved!*

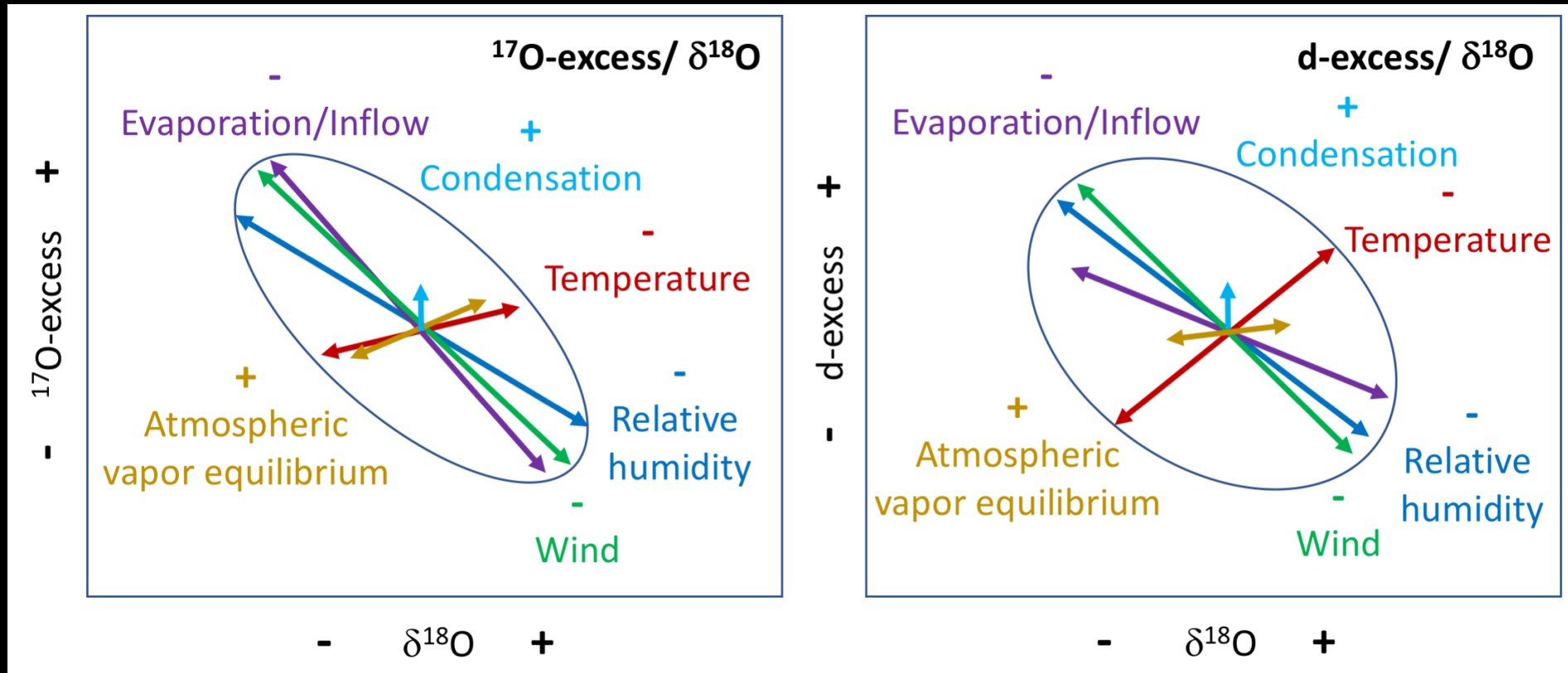


*Gypsum hydration water
after extraction by heating
the gypsum sample*

How are triple oxygen isotopes in gypsum useful?

These diagrams illustrate the environmental controls on isotope space in gypsum hydration water.

Example: with lower temperature, the d-excess increases more than the ^{17}O -excess (because d-excess is more temperature sensitive than ^{17}O -excess)

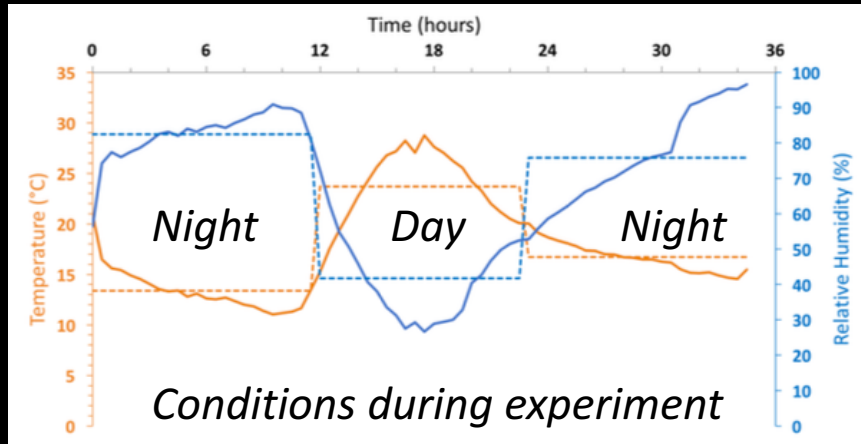


*figure adapted
from Gázquez
et al., 2018*

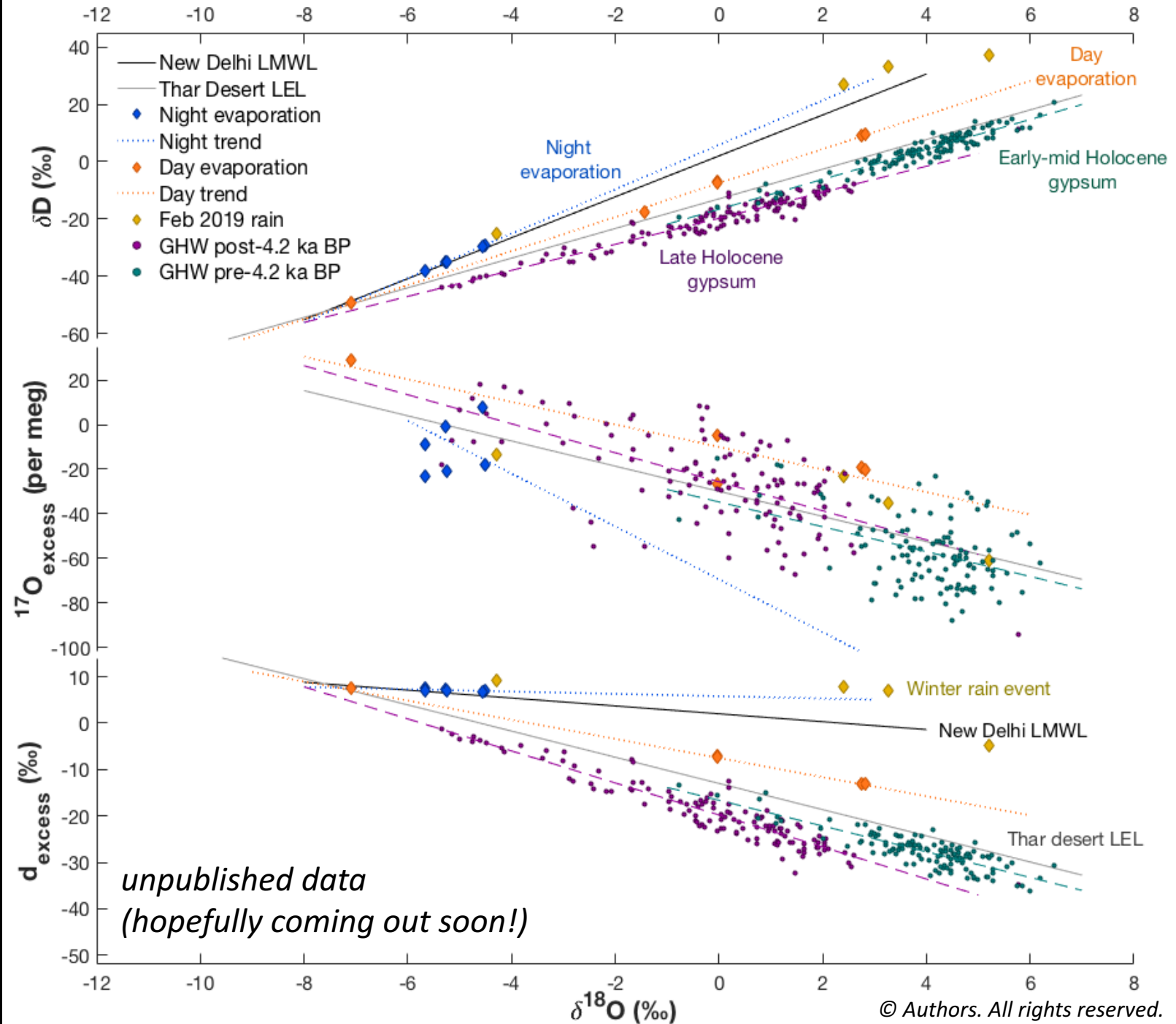
- Measuring triple isotopes helps distinguish shifts in relative humidity and temperature

Onsite pan evaporation experiment (Feb. 2019)

- Shows distinct day- and night-time evaporation trends, related to temperature and relative humidity conditions

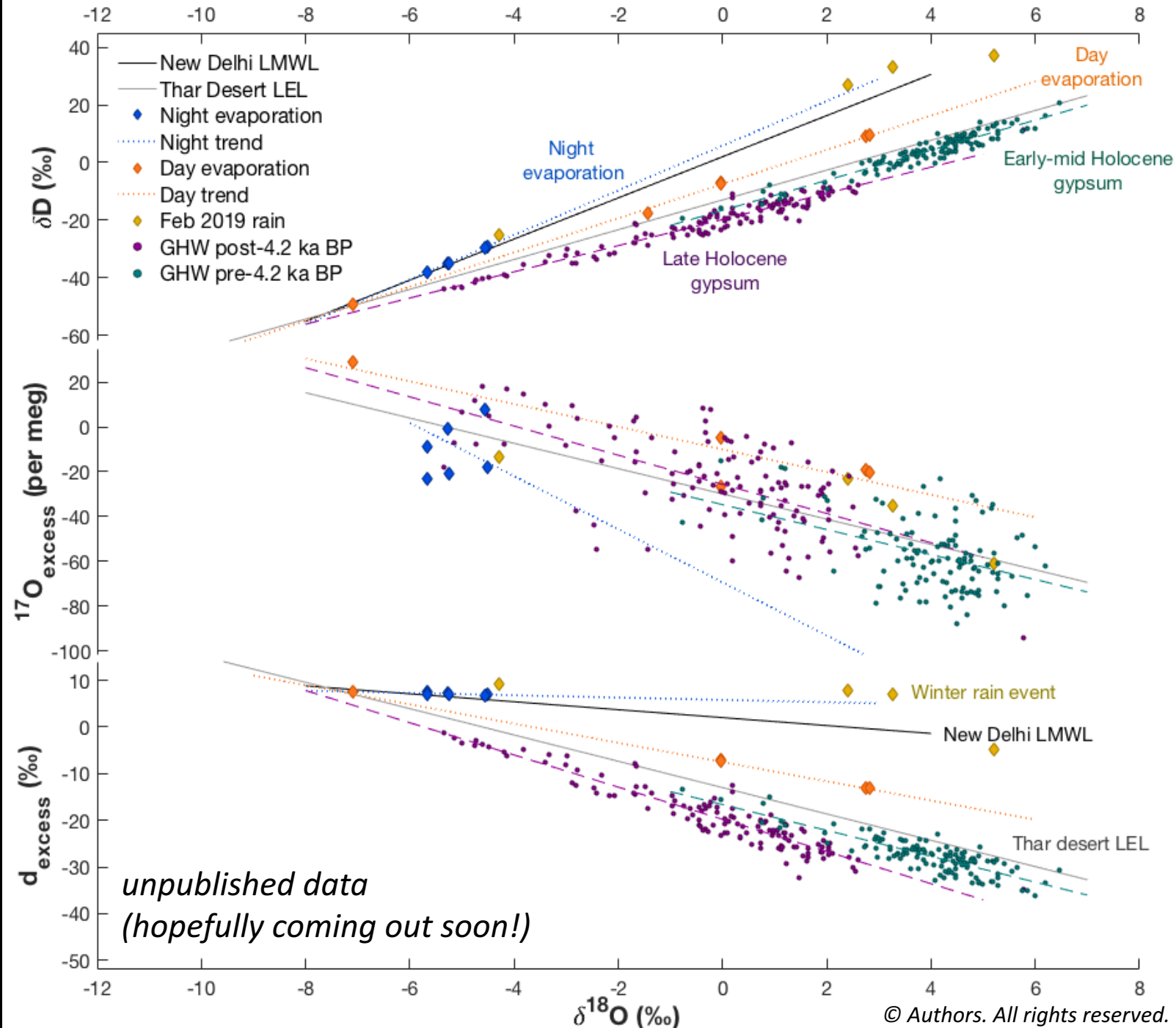


- Suggests that gypsum hydration water from Holocene deposits preserves a climate signal!



Playa data

- Khajuwala, Lunkaransar, and Karsandi data compiled in figure
- Environmental conditions differ between Late Holocene and Early-mid Holocene gypsum
- Triple oxygen isotopes help identify shallow v. deep playa systems, which turns out to be critical for climatic interpretation



Conclusions

- **Very few available proxies for climate/environment in arid regions:** triple oxygen isotopes in gypsum hydration water is opening new doors (but needs to be used carefully depending on each site's characteristics)
- Triple oxygen isotopes of gypsum can help distinguish past changes in relative humidity and temperature

Thank you!

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