



# **TERRESTRIAL HABITATS IN THE LATE MIOCENE PANNONIAN BASIN SYSTEM FROM STABLE ISOTOPES IN THE HORSE *HIPPOTHERIUM***

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# Questions

- How do aquatic and terrestrial ecosystems respond to global climate change?
- How do terrestrial and aquatic systems interact?
  - Sensitivity to rivers, precipitation, evaporation?
  - Change in runoff?





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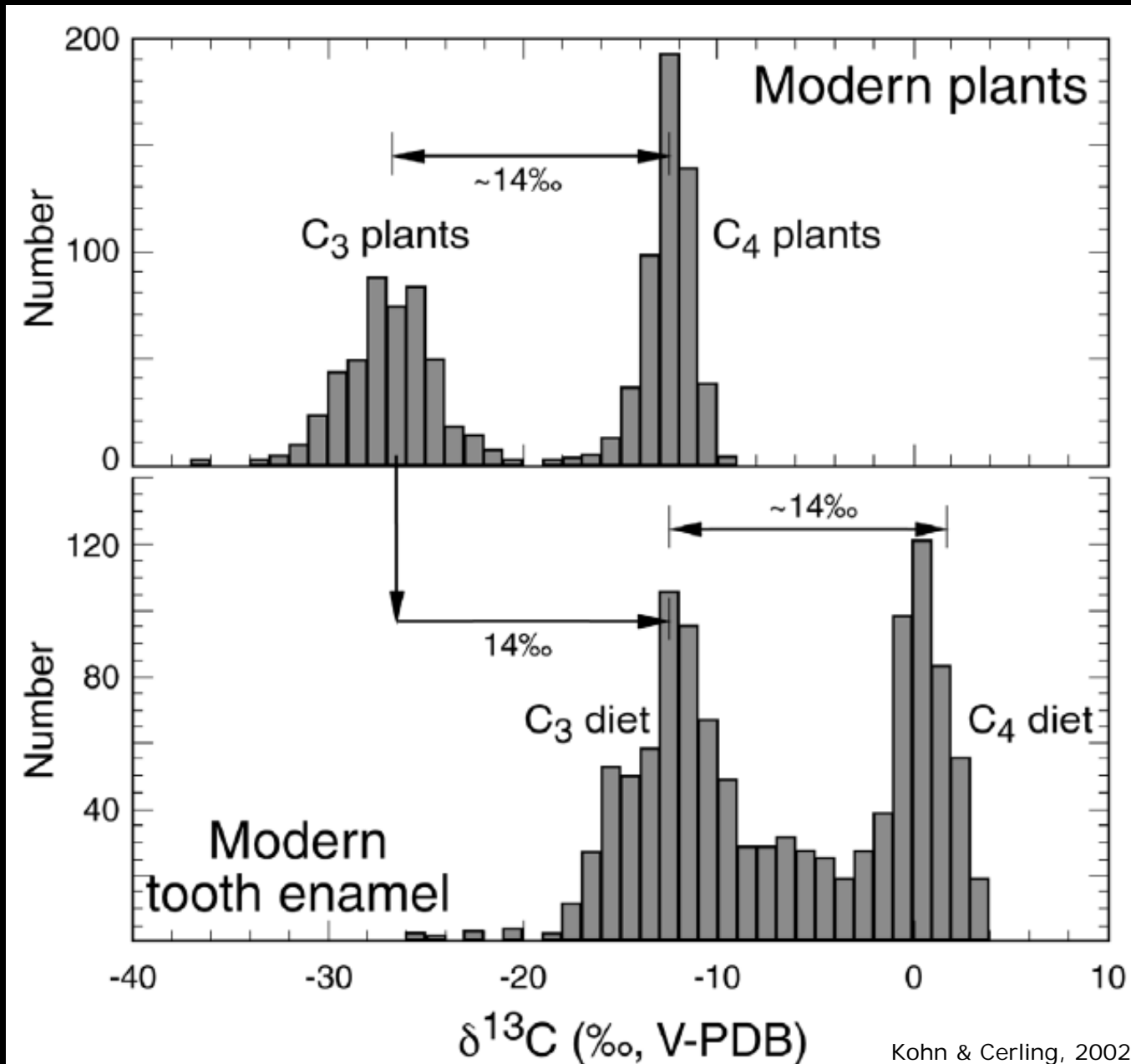
# Motivation

- $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  are often used to track the marine to freshwater transition in Lake Pannon
- Prior assumptions
  - $\delta^{18}\text{O}$  of inflow constant
  - Terrestrial  $\delta^{13}\text{C}$  reflects regional climate
- Assumptions can be tested with fossil mammals

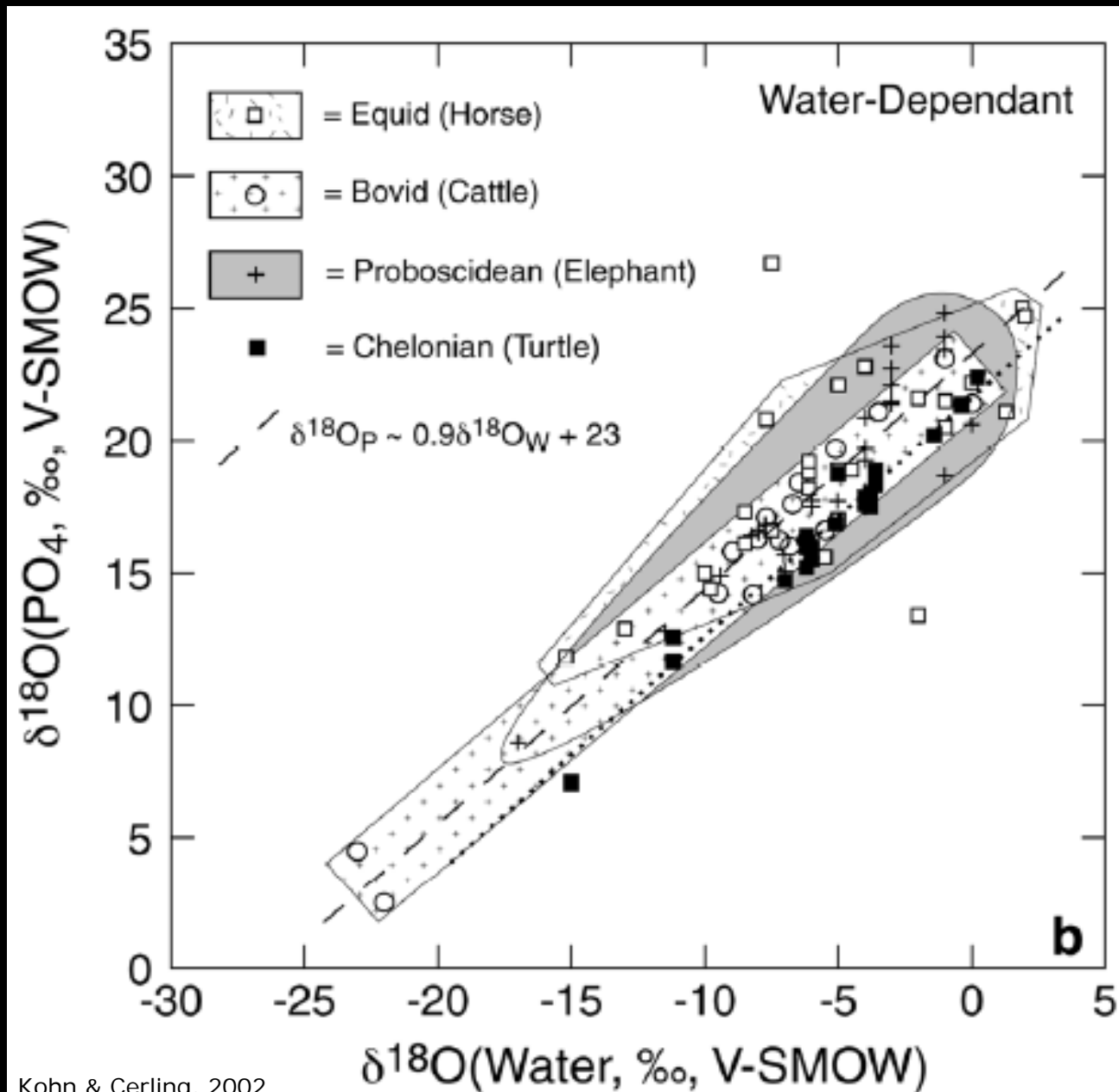


Right M2 of *Hippotherium primigenium* from Phyra, Austria. NHMW 2007/0112/0000

# $\delta^{13}\text{C}$ in Mammals Reflects Diet

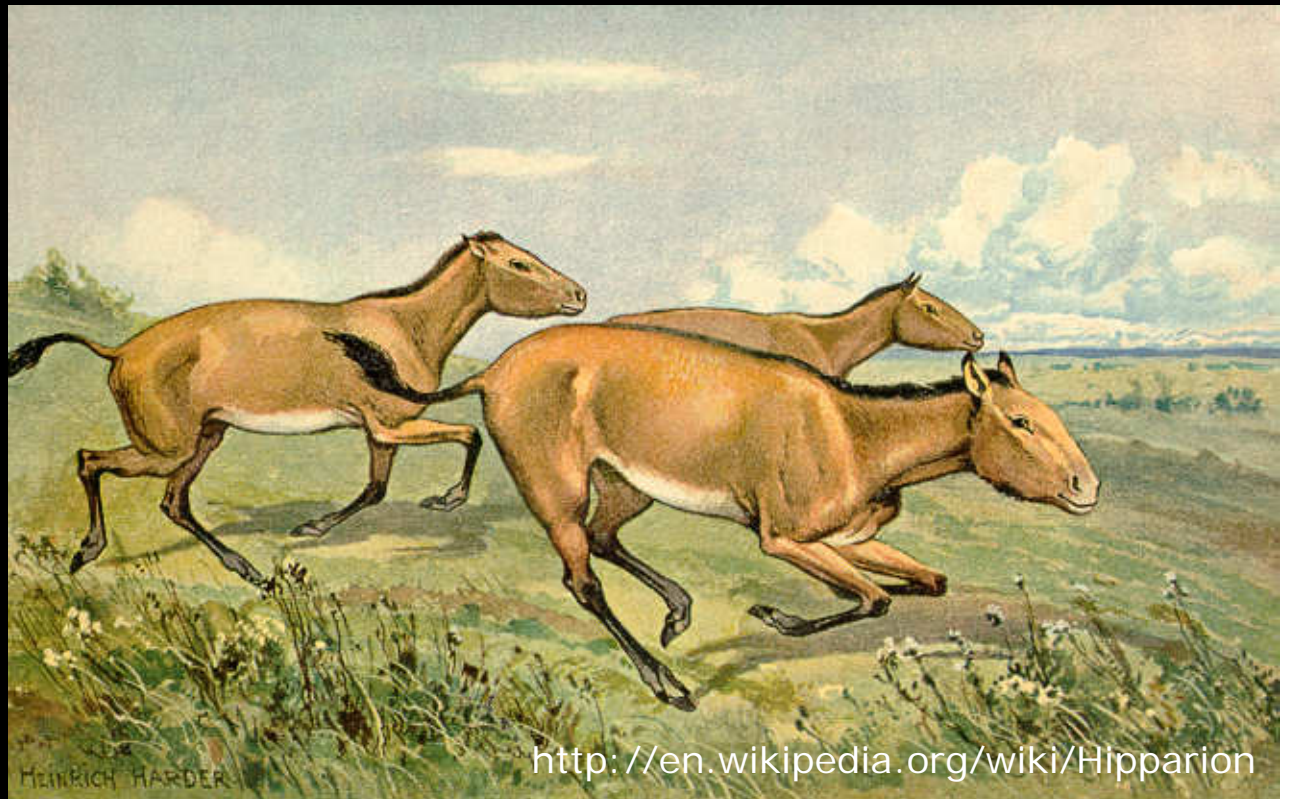


# $\delta^{18}\text{O}$ in Mammals Reflects Drinking Water



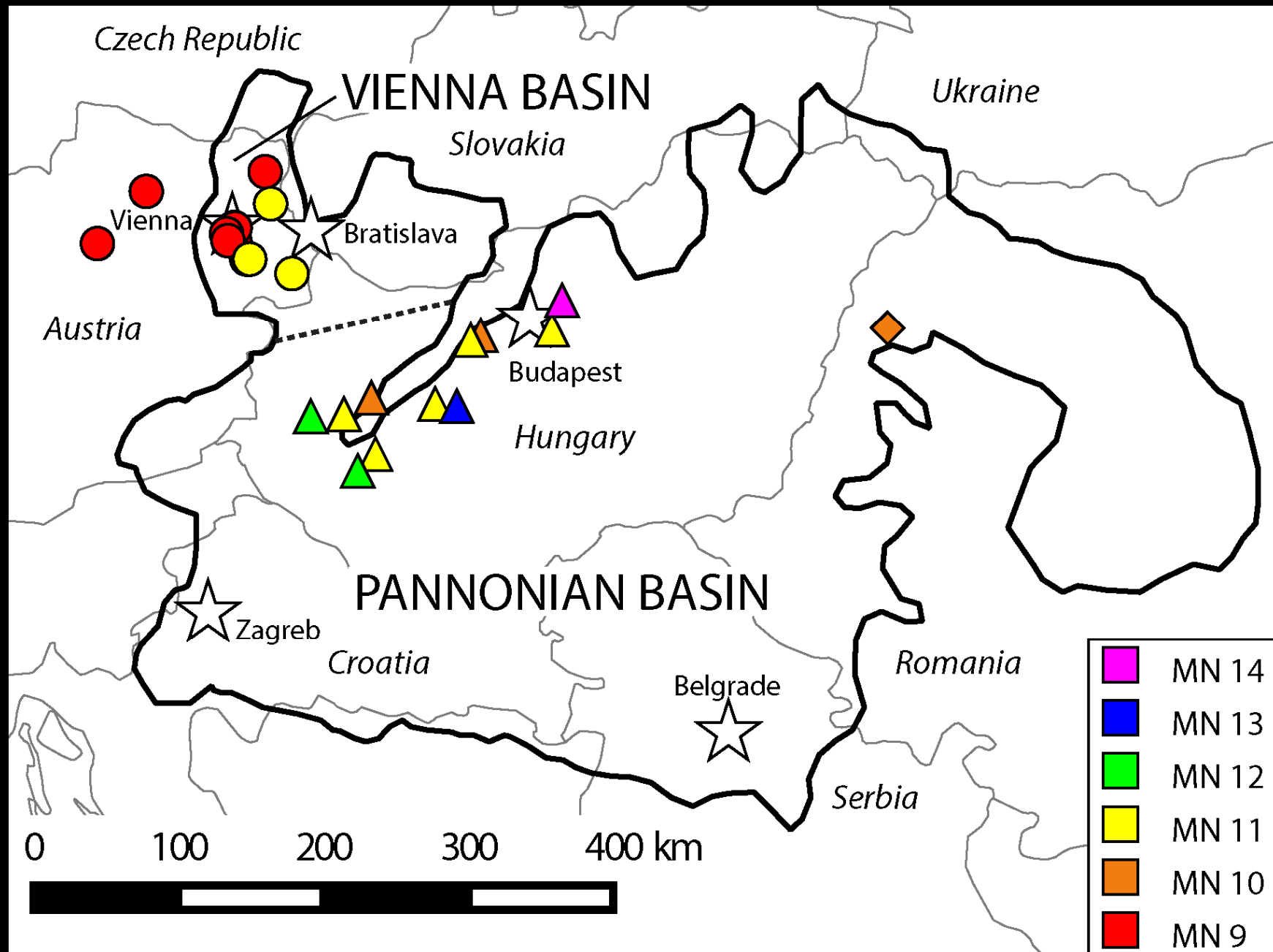
# Why *Hippotherium*?

- First appearance in Europe ~11.2 Ma
- Widespread, very common through Late Miocene
- Found in a variety of habitats
- Opportunistic feeders



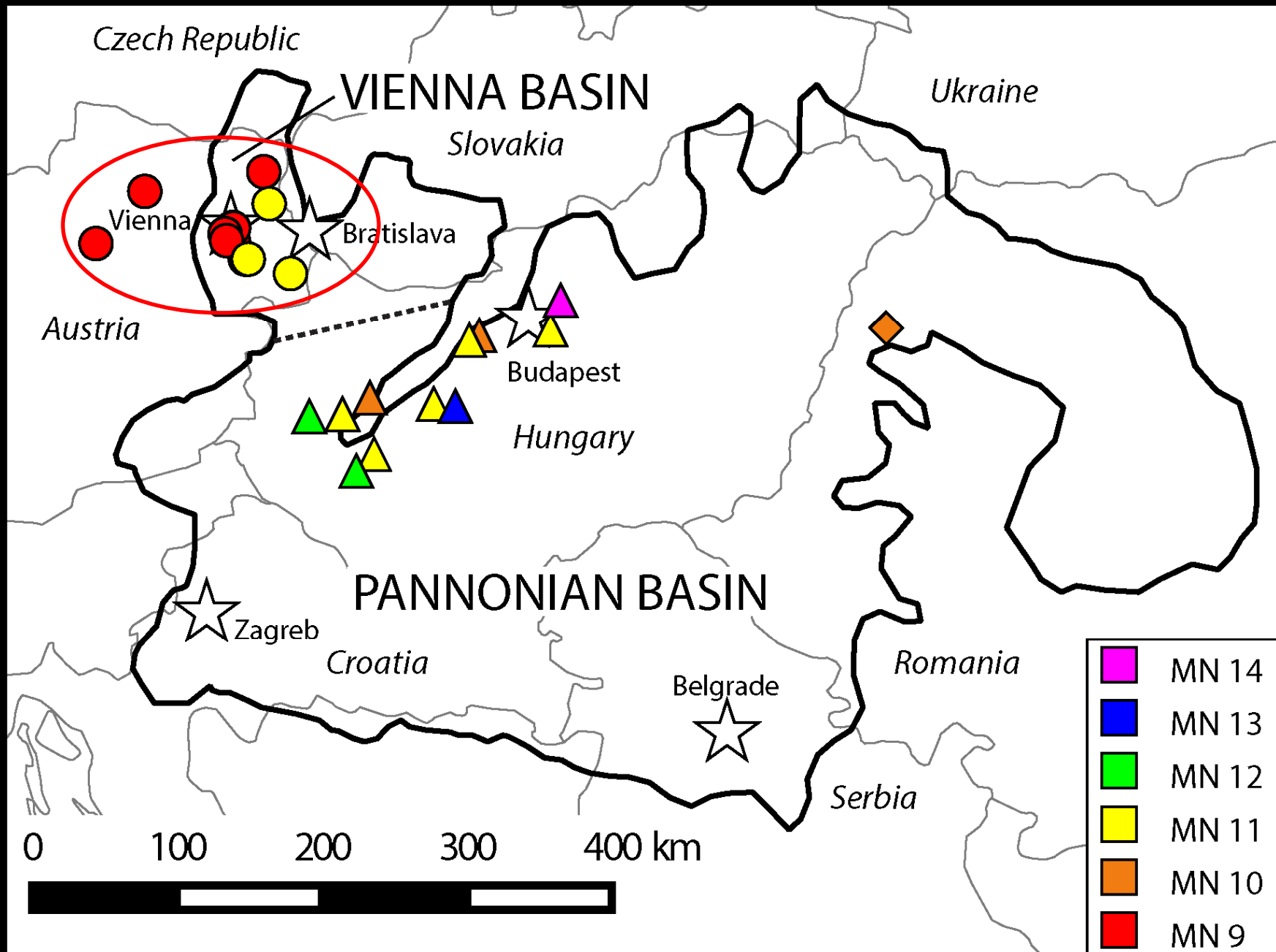
<http://en.wikipedia.org/wiki/Hipparion>

# Sample Localities

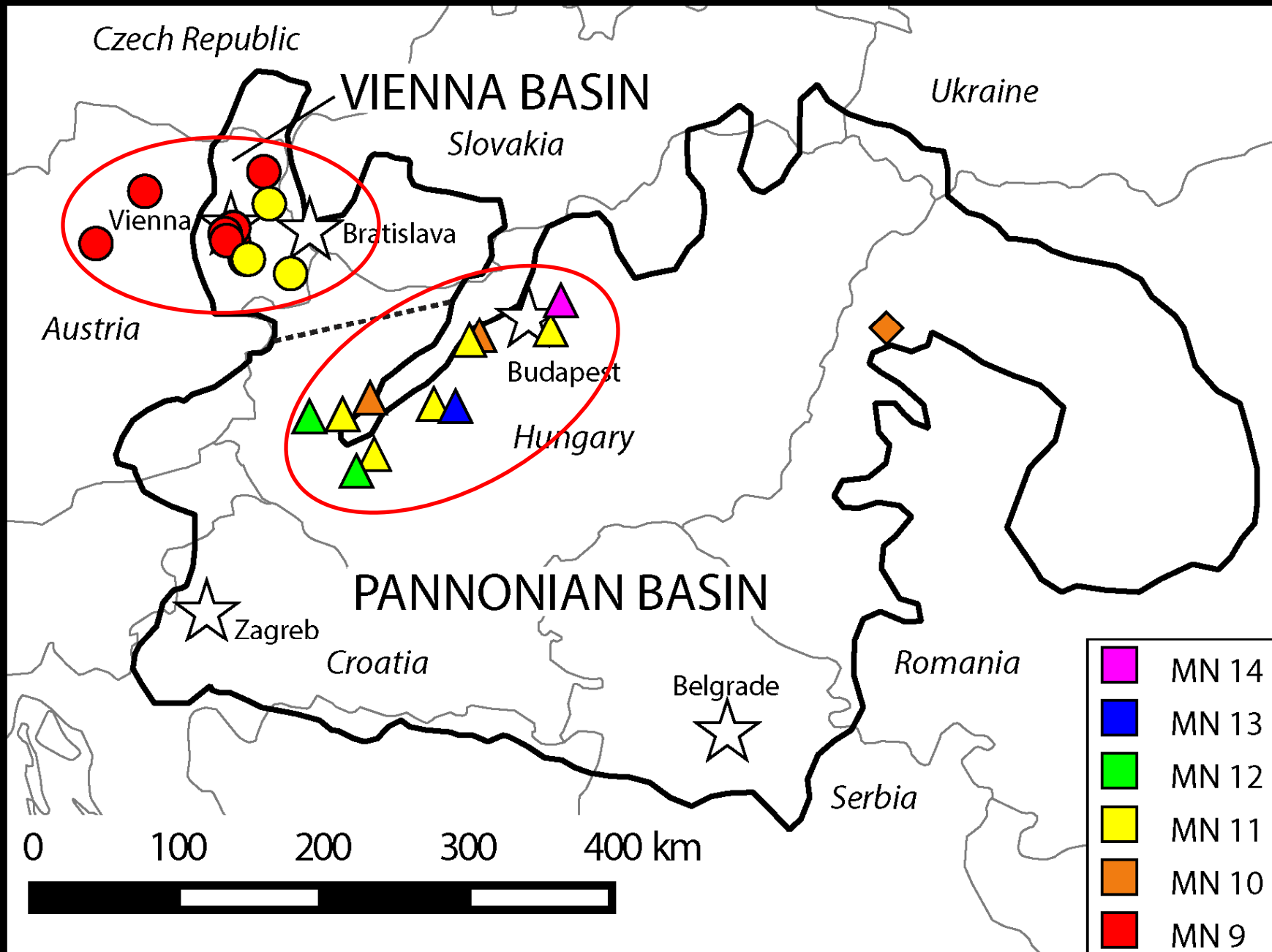




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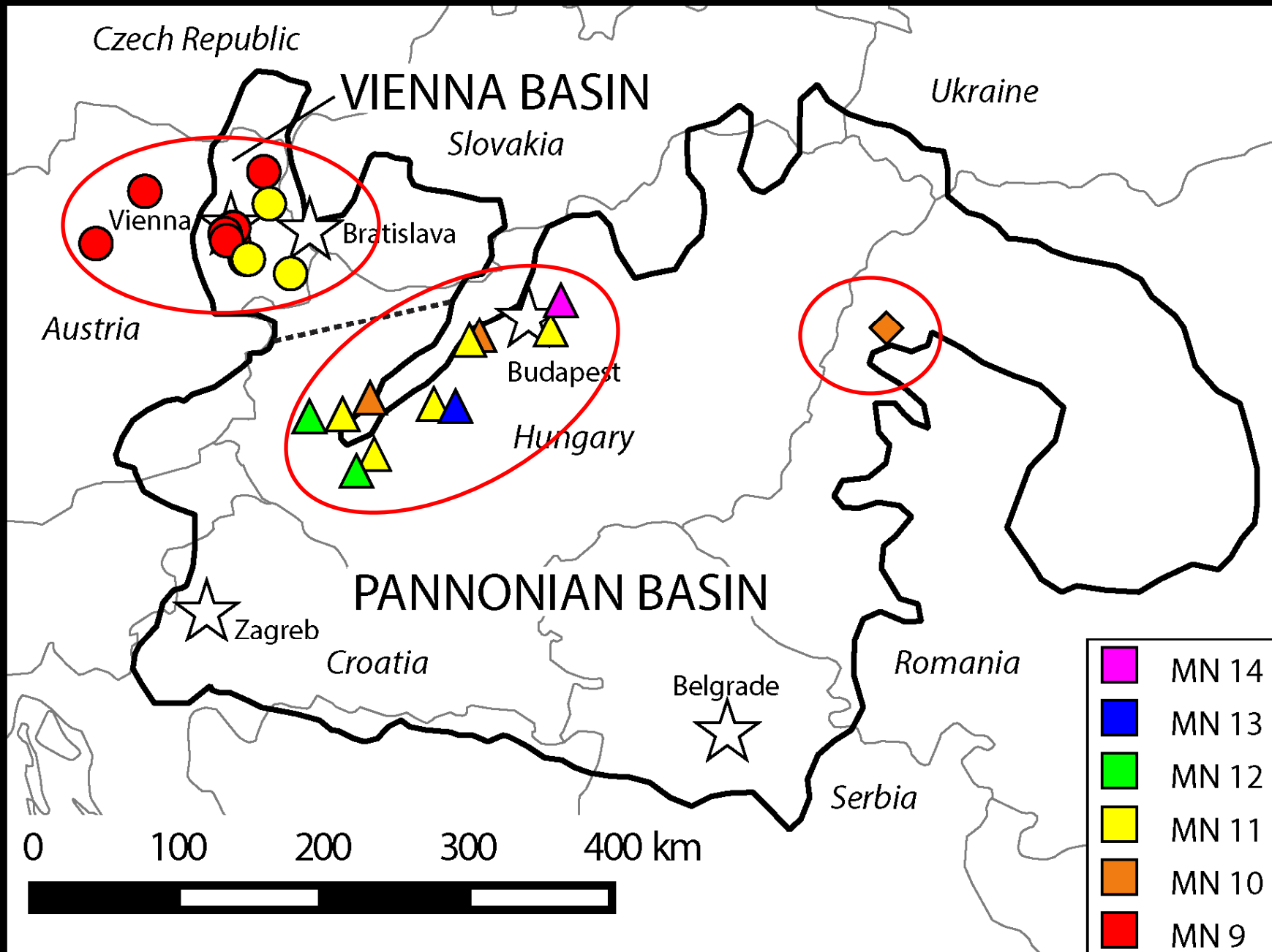


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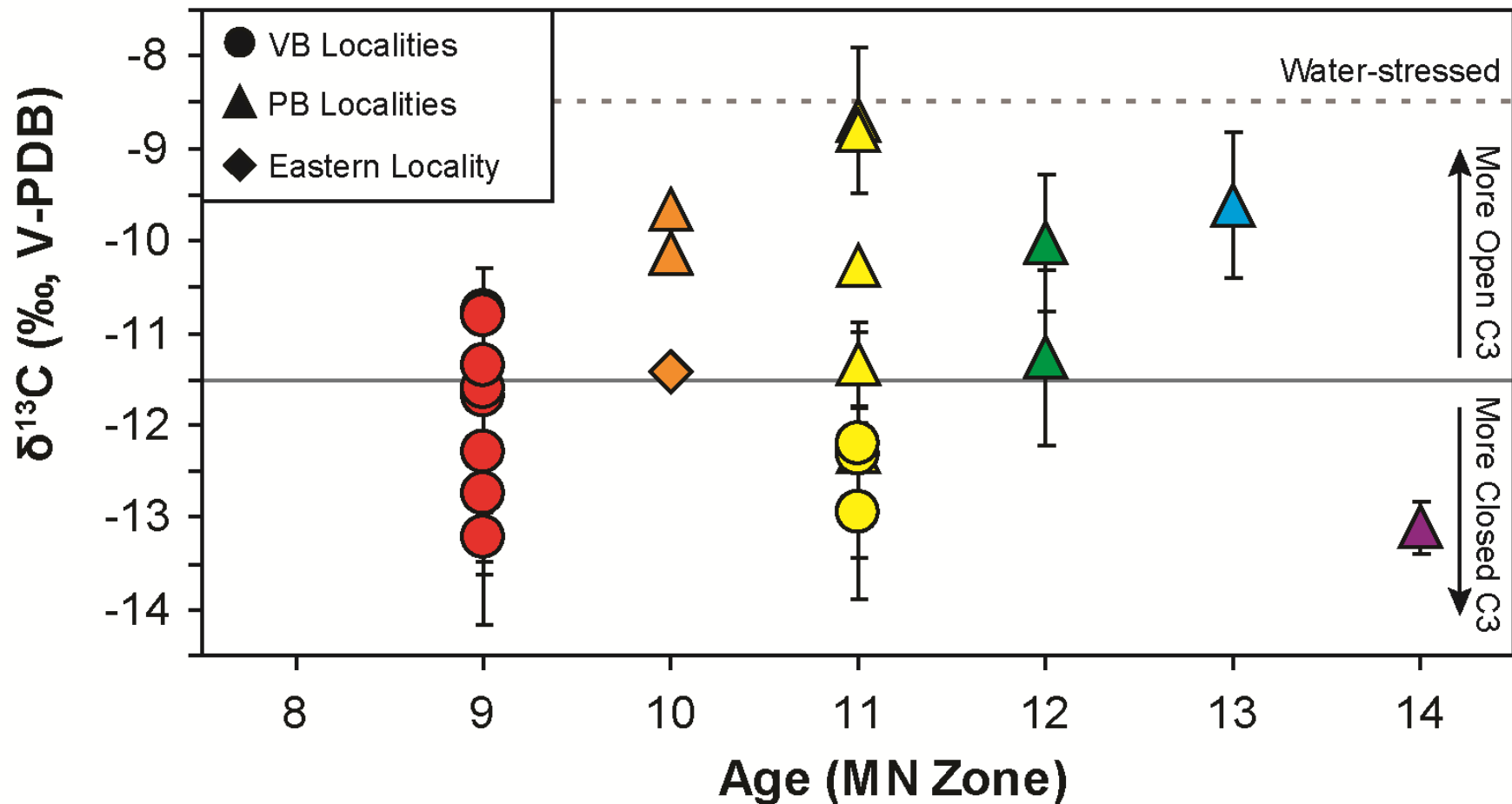




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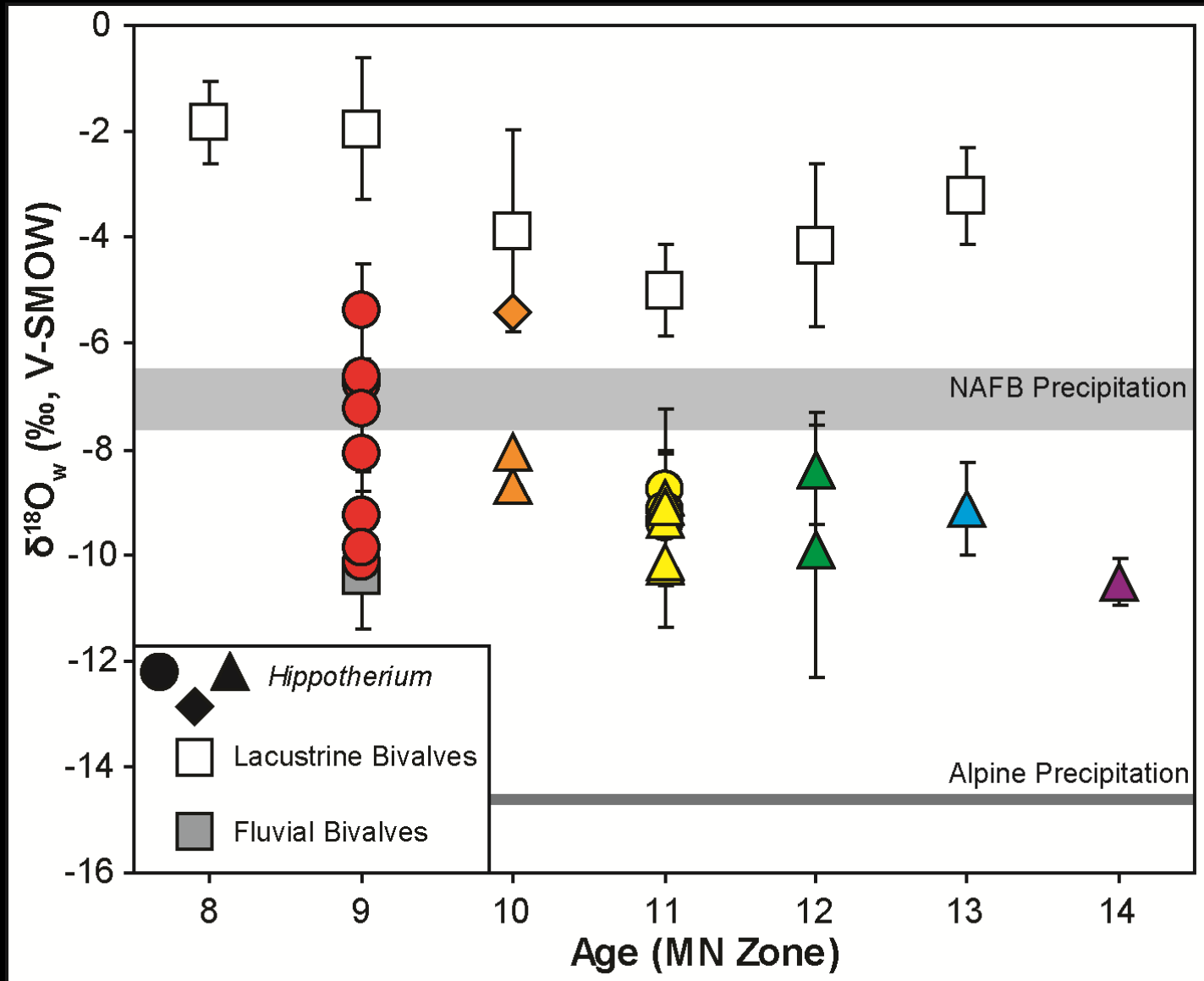
# *Hippotherium* $\delta^{13}\text{C}$ Record



- No evidence of substantial C4 vegetation
- $\delta^{13}\text{C}$  values generally lower in the Vienna Basin

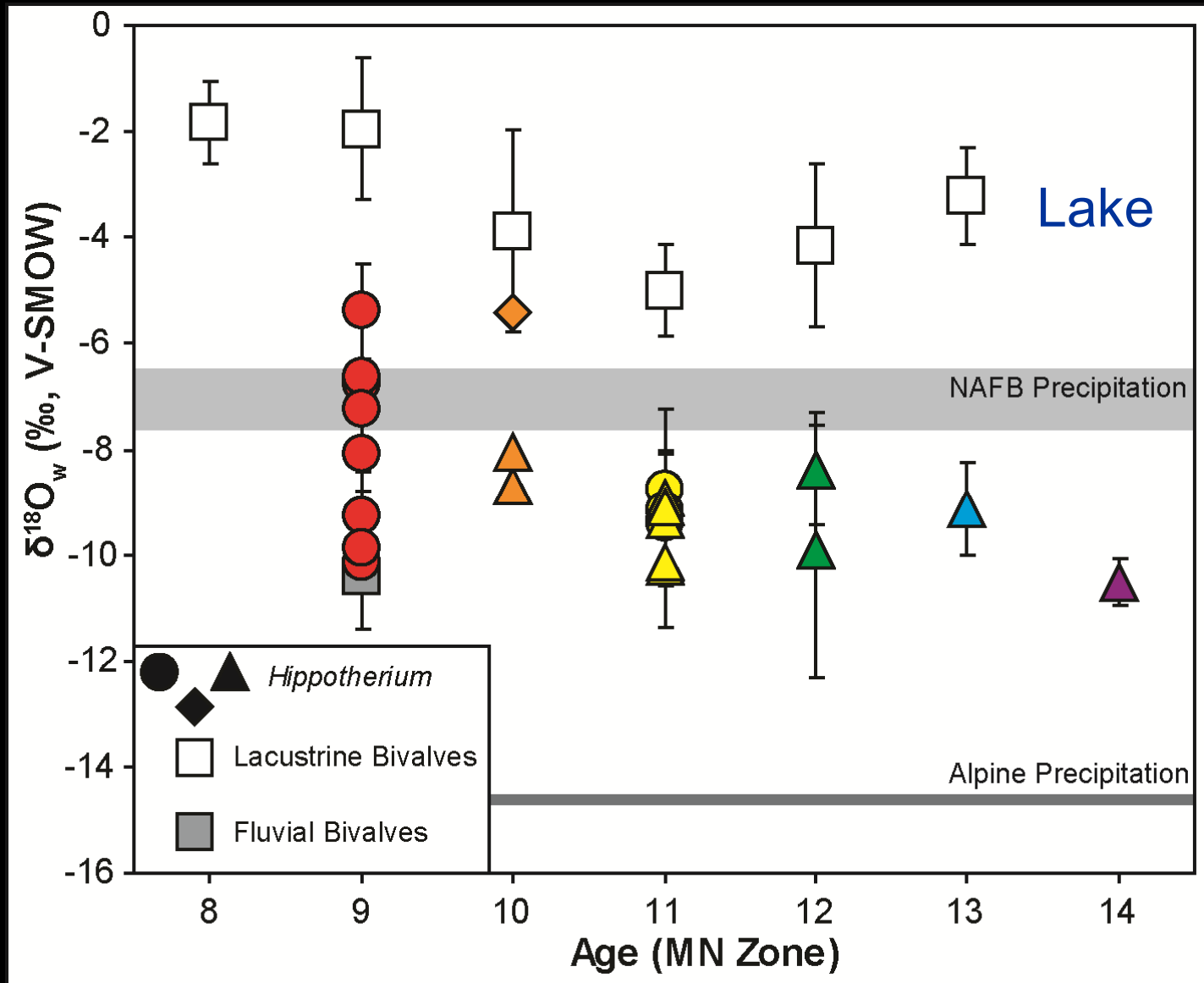


# Hippotherium $\delta^{18}\text{O}$ Record



Lacustrine bivalves from Geary et al., 1989; Mátyás et al., 1996;  
 Harzhauser et al., 2007; Geary et al., 2012  
 Fluvial bivalves from Harzhauser et al., 2007  
 Precipitation from Campani et al., 2012

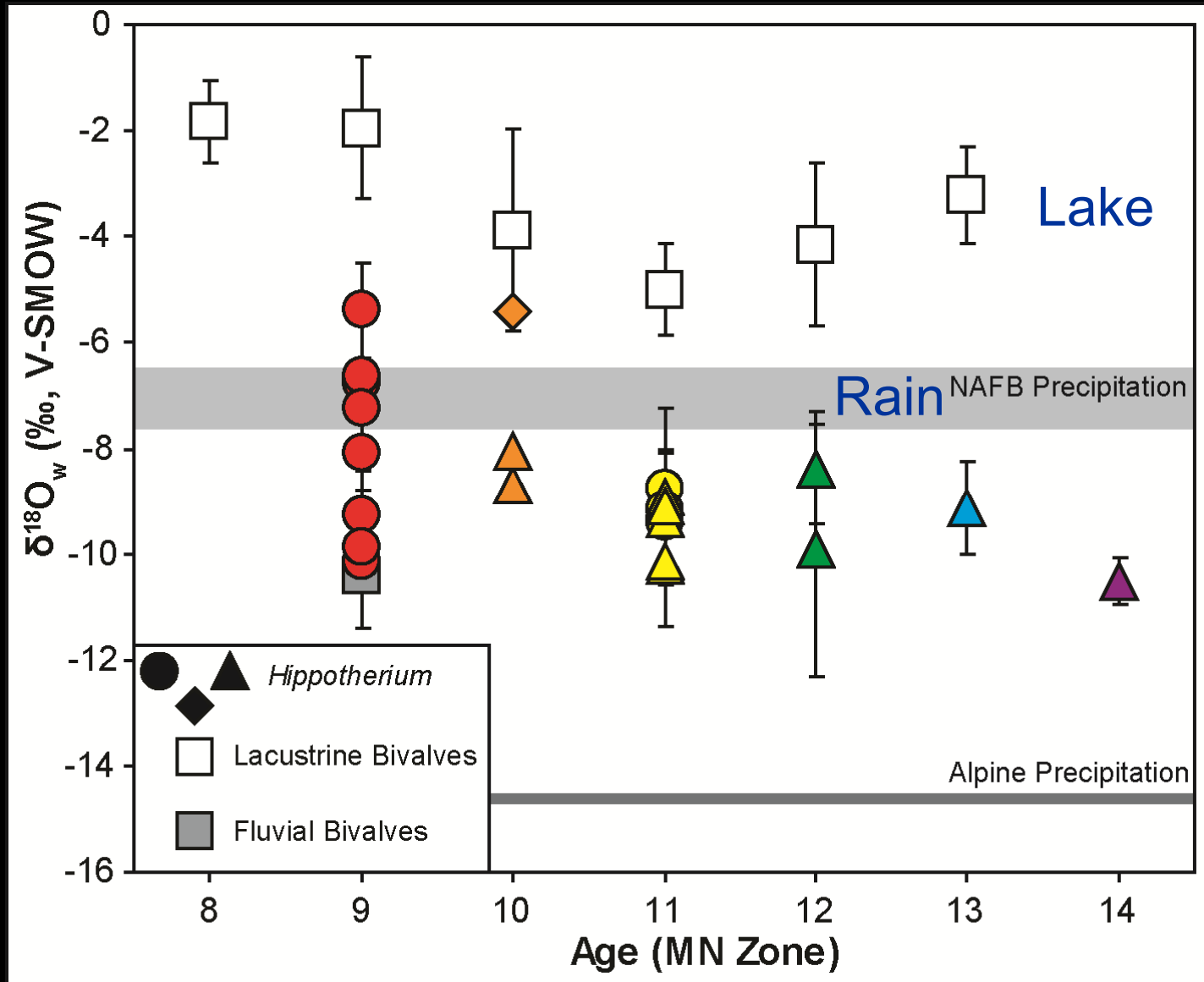
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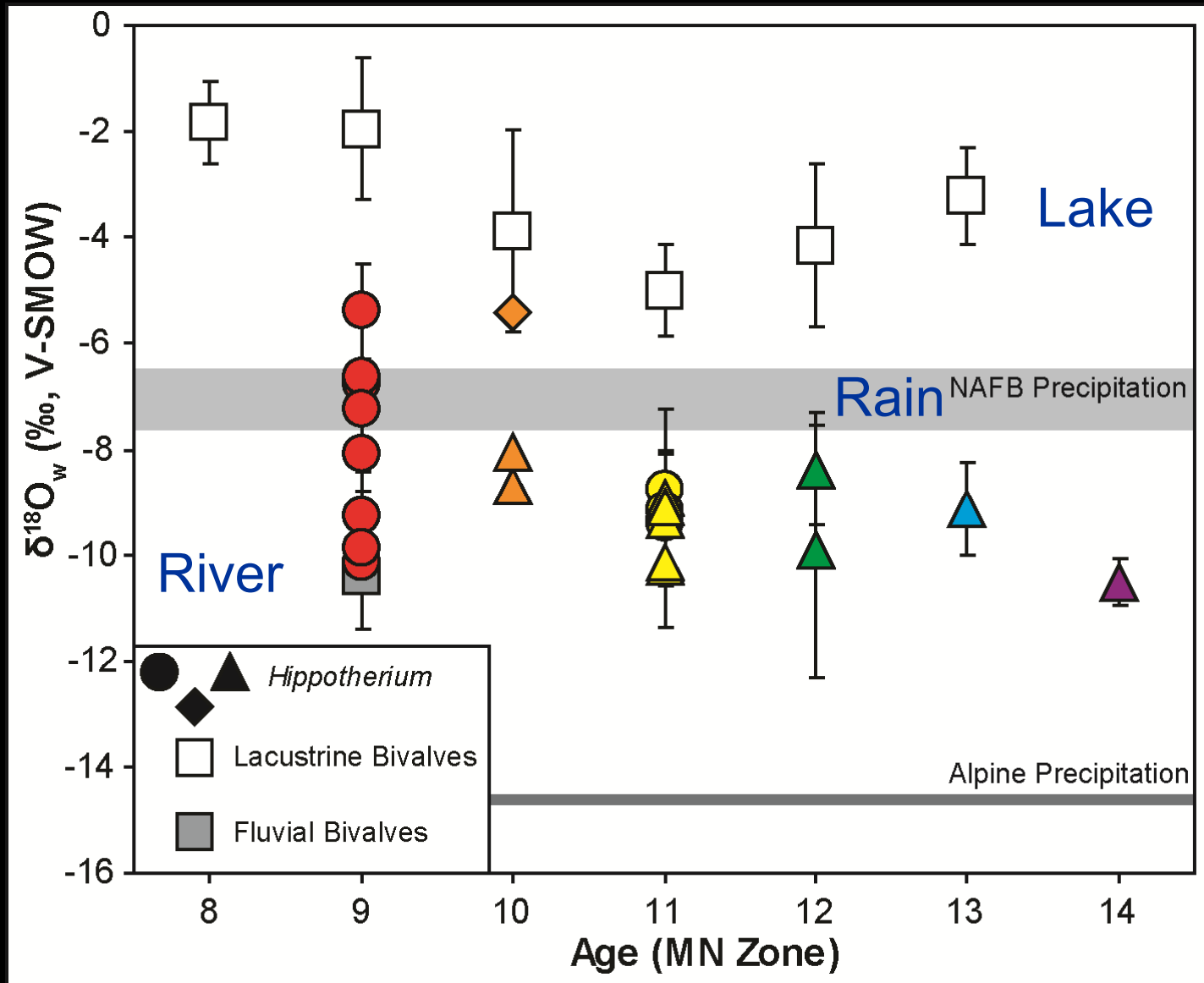


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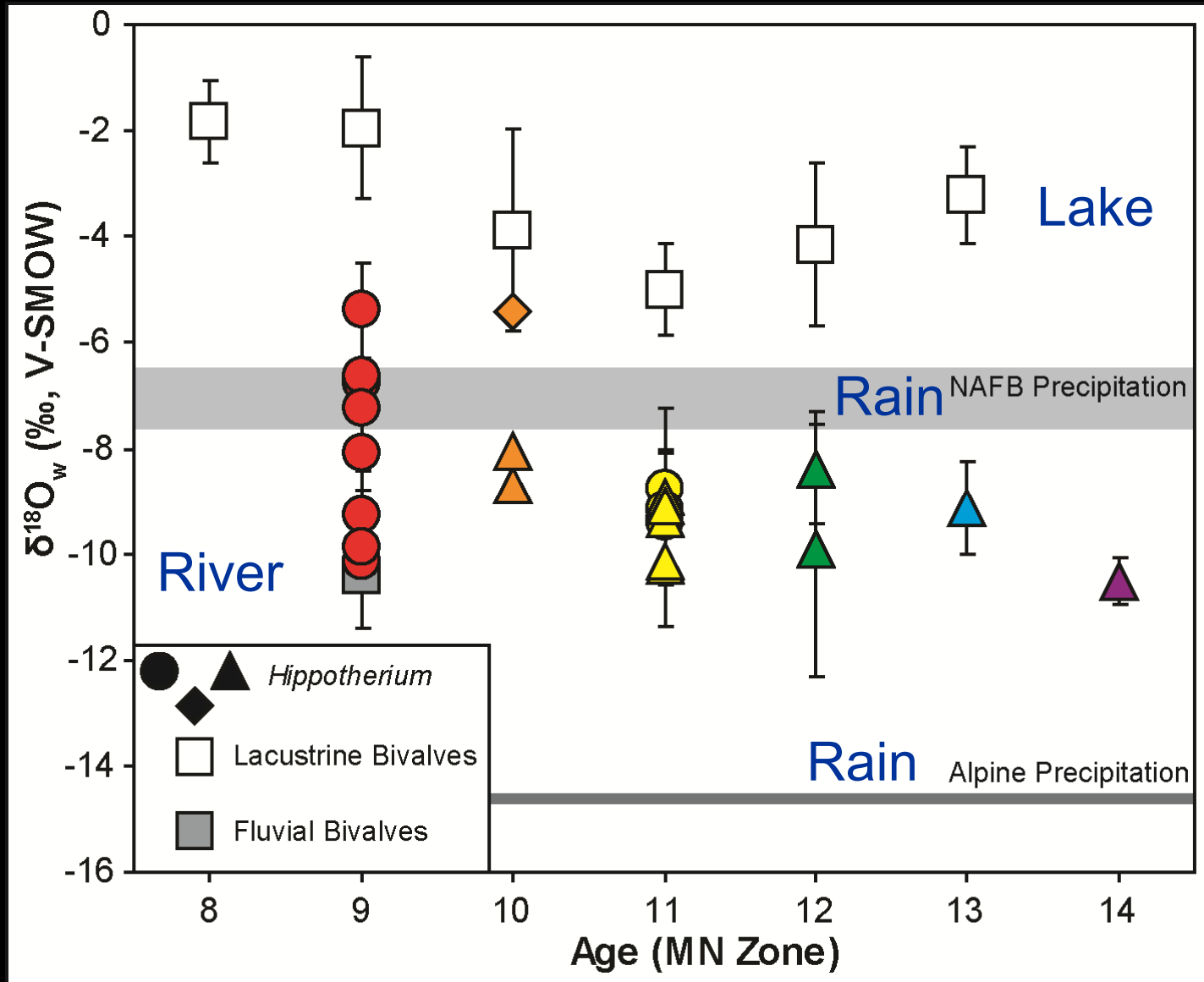
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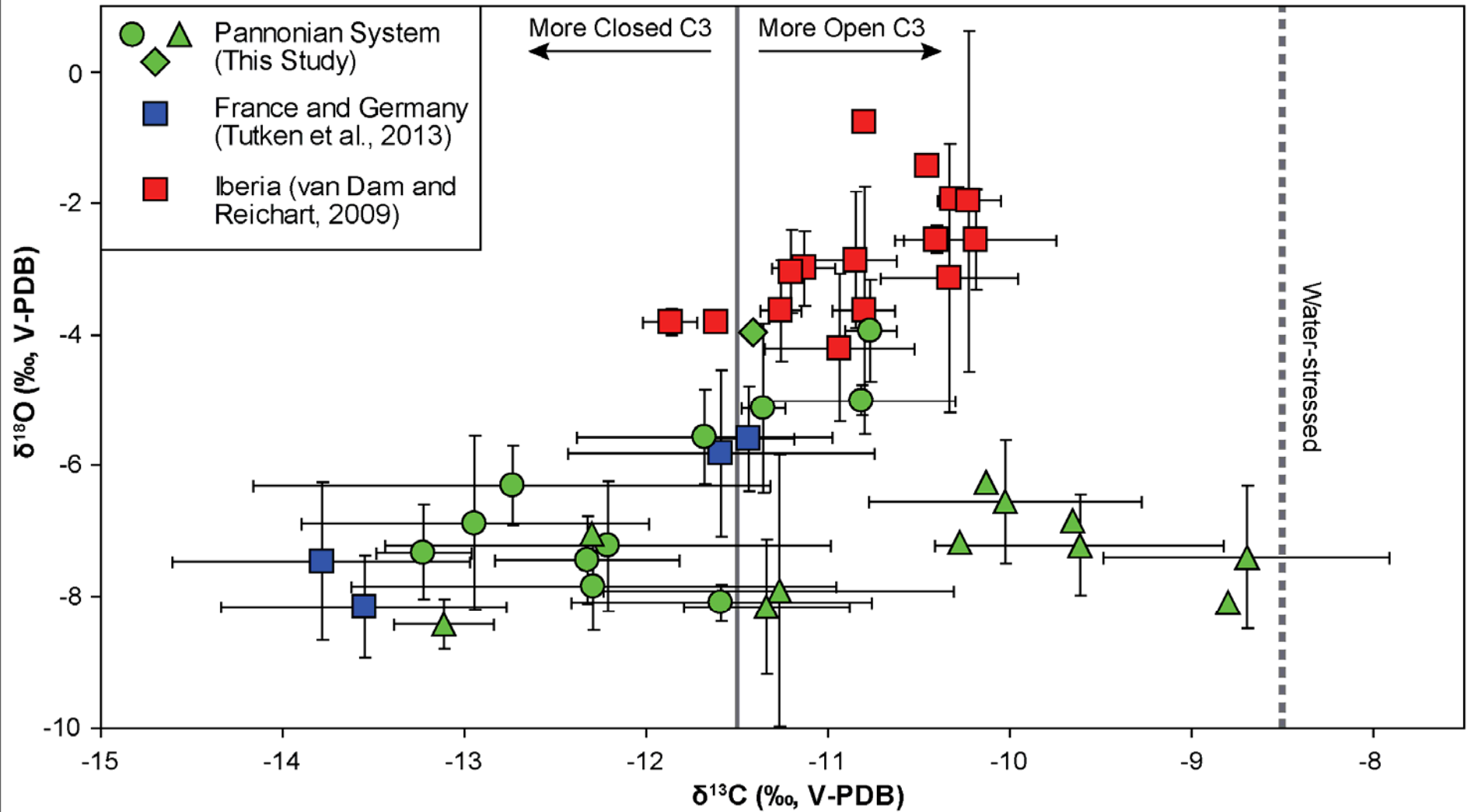


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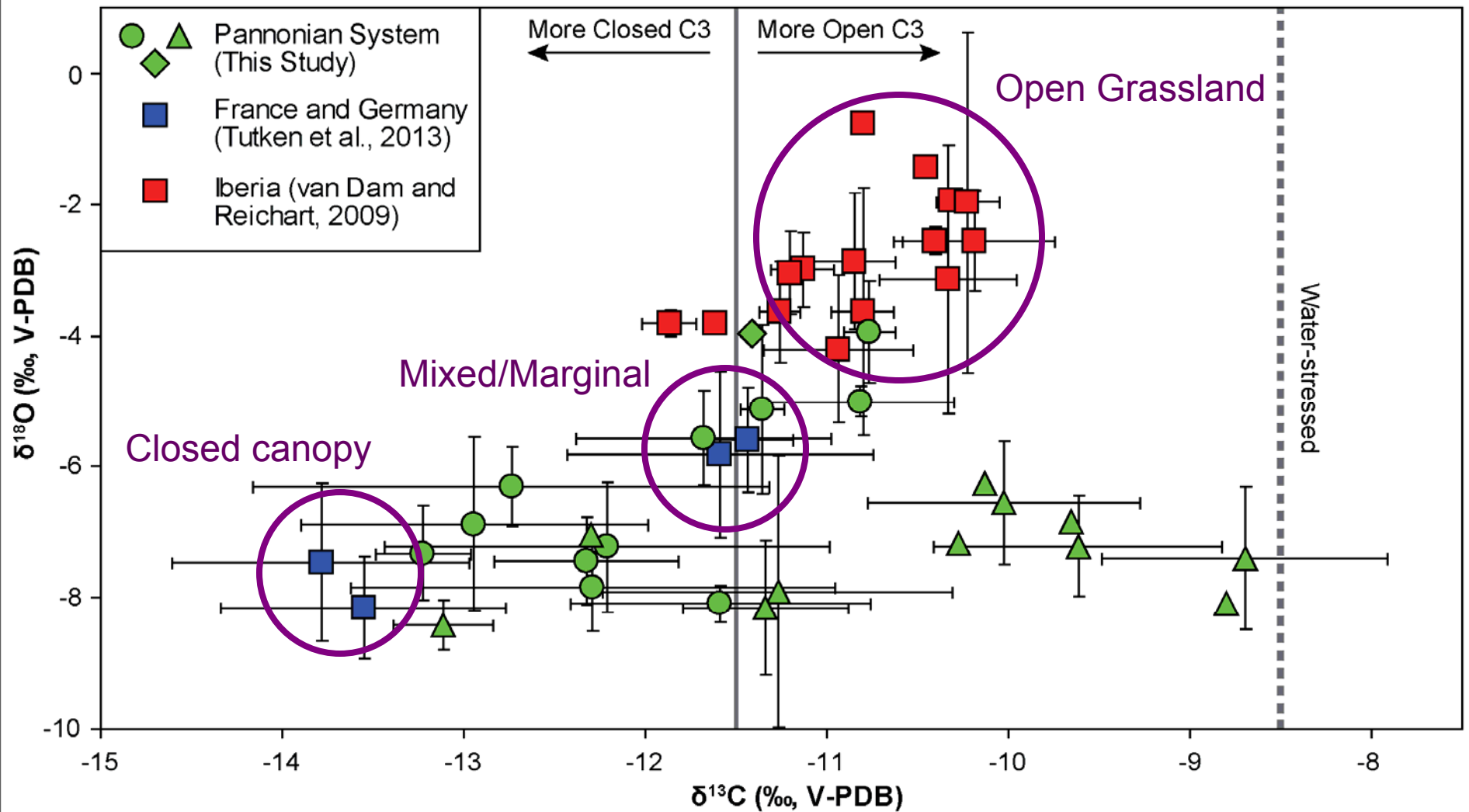
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# Pannonian Habitats

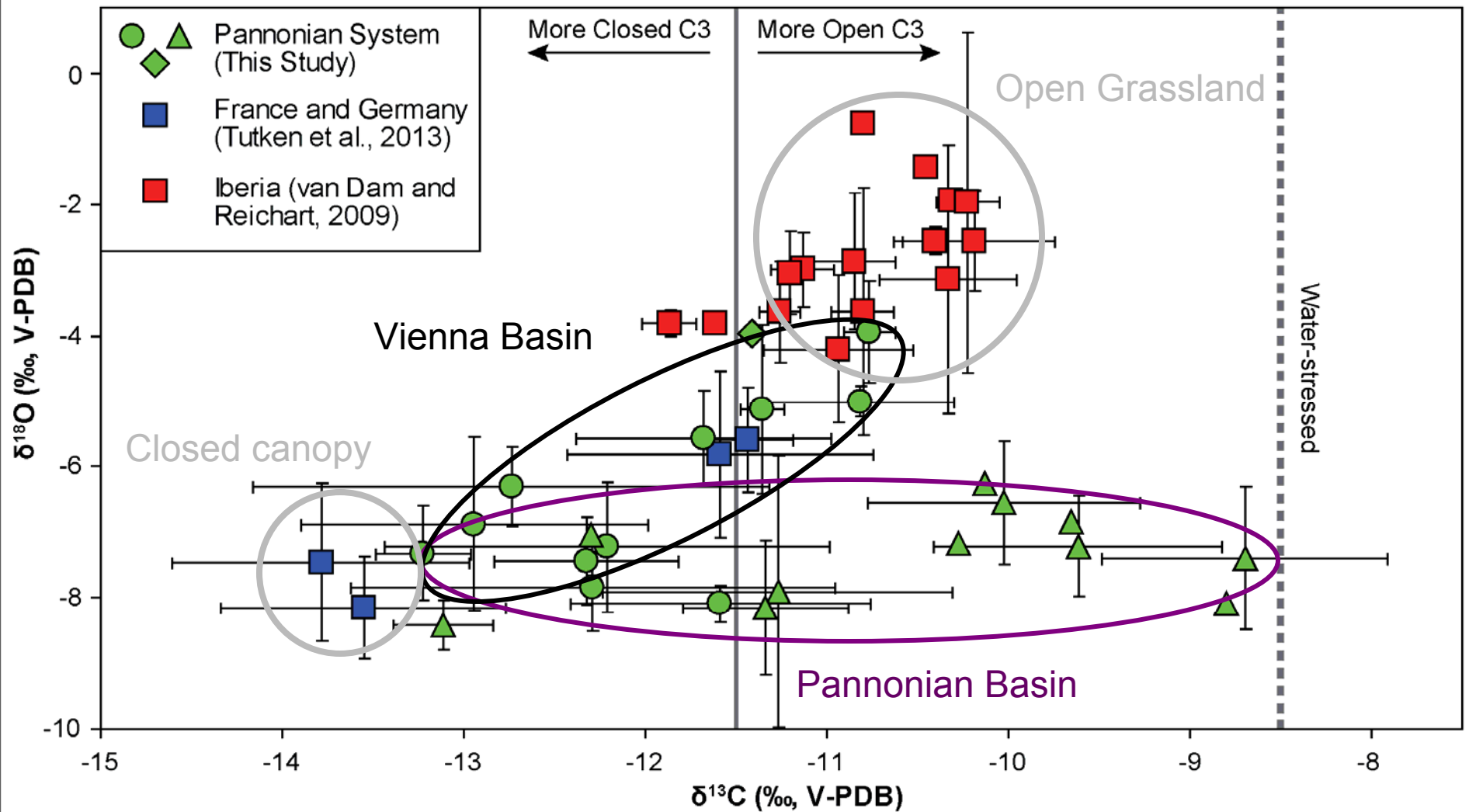




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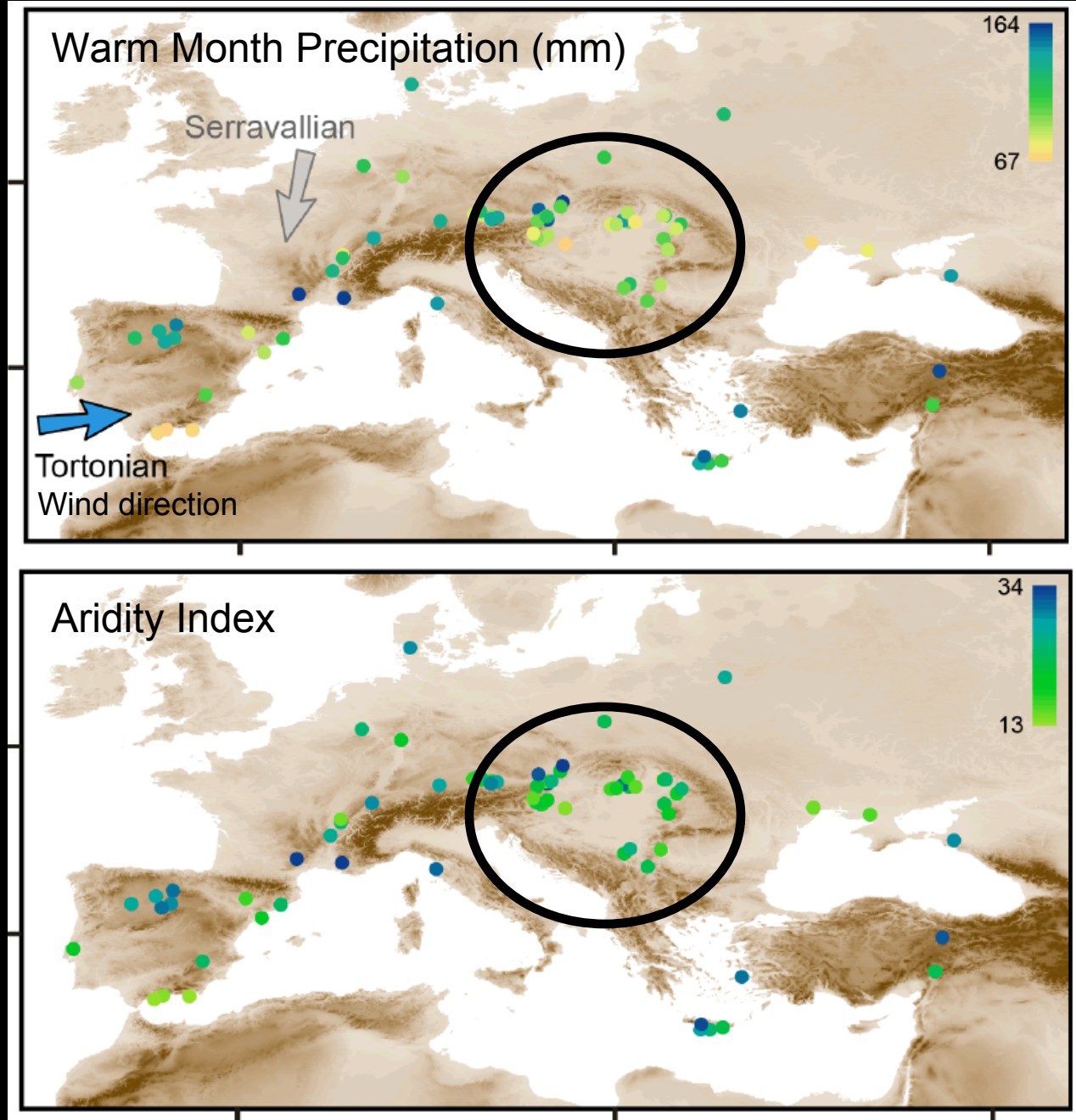


# Pannonian Habitats



# Late Miocene Aridity

- Pannonian Basin dry compared to Vienna Basin
- Alps and Dinarides create rain shadow
- Drinking water derived from high elevation precipitation
- Diet derived from more water-stressed vegetation





# Conclusions and Future Work

- Pannonian System *Hippotherium* exploited a mix of forested and open habitats
  - Pannonian drier than Vienna
  - No apparent C4 expansion
- *Hippotherium*  $\delta^{18}\text{O}$  reflects a mix of low elevation precipitation and high elevation runoff
  - Lake transitions can be modeled using terrestrial inputs
  - How does lake sensitivity to rainfall / rivers change?
  - When did freshwater conditions prevail?
- Understanding terrestrial ecosystems constrains lacustrine parameters, and can lead to more accurate environmental reconstructions.

# Acknowledgments

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