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BIOLOGICAL WEATHERING BY THE DEVONIAN TREES

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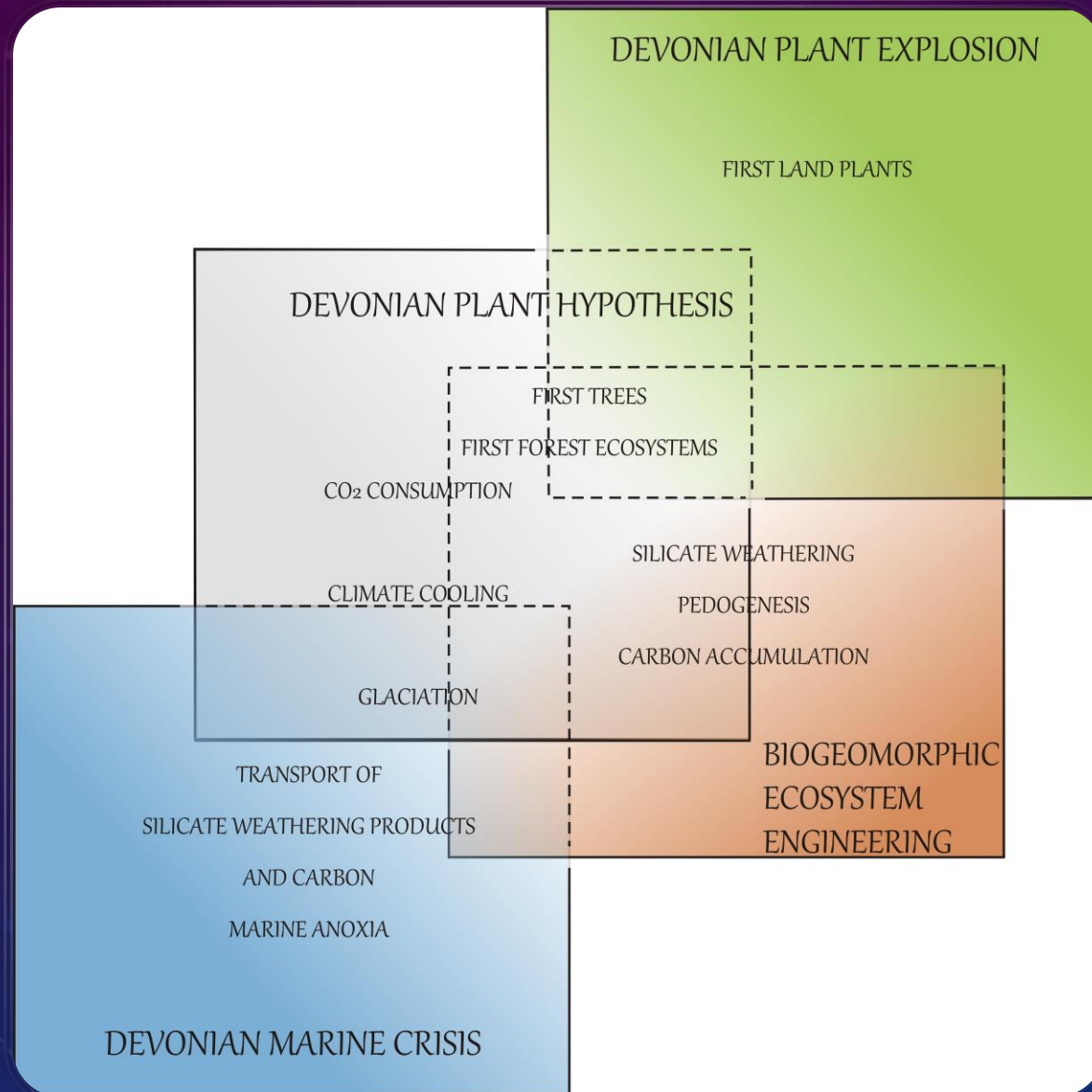




FIRST TREES AND FORESTS

Evolution of terrestrial plants, the first vascular plants, the first trees, and then whole forest ecosystems had far reaching consequences for Earth system dynamics. These innovations are considered important moments in the evolution of the atmosphere, biosphere, and oceans, even if the effects might have lagged by hundreds of thousands or millions of years.

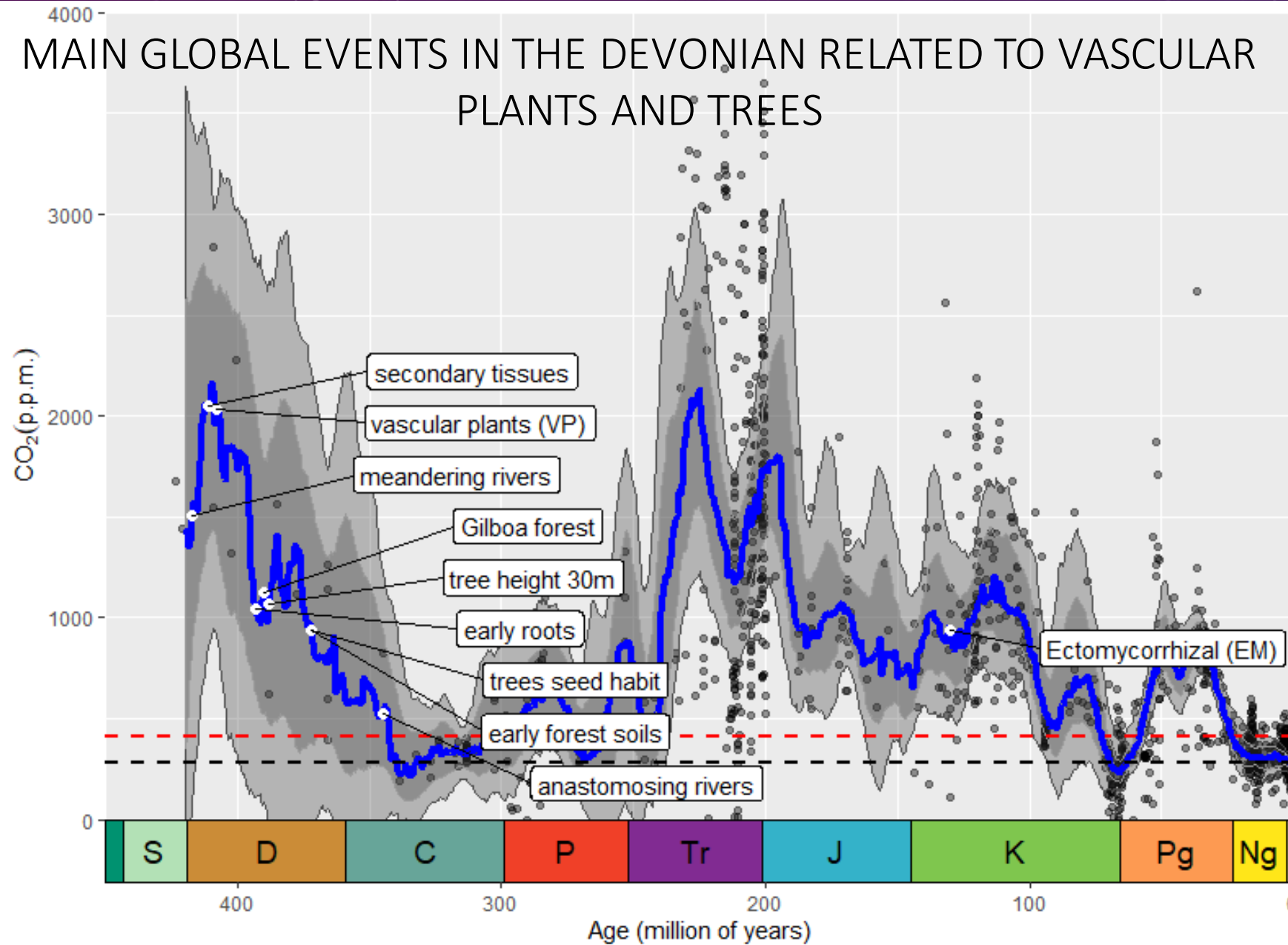
Photo: Pawlik, 2019



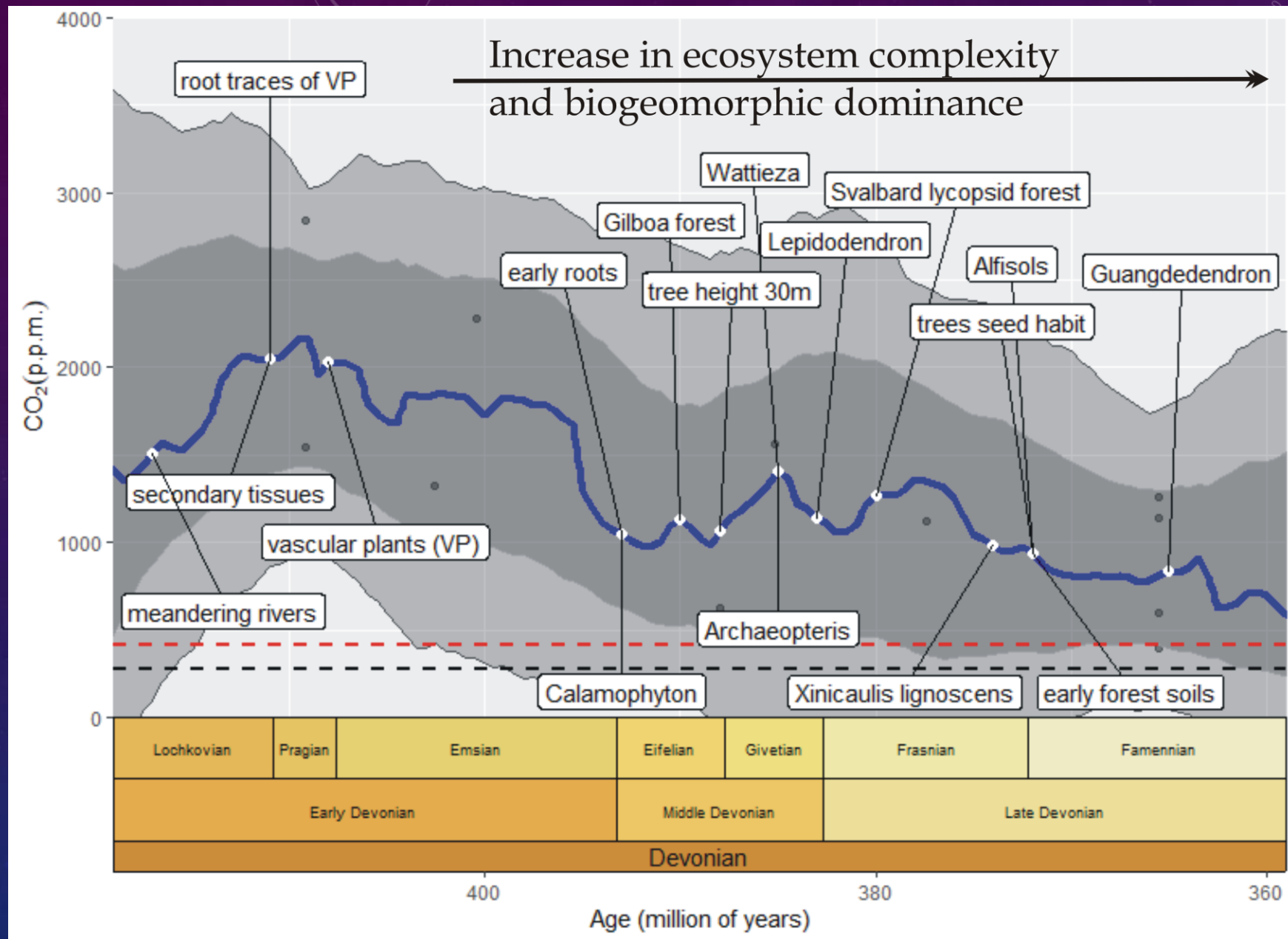
STUDY CENCEPT

- We explore the role and significance of the evolution of trees in the Devonian Plant Explosion as it relates to global climate at that time and the Devonian Marine Crisis.
- Trees are a powerful driver of geomorphic change, and we explore their effectiveness as Biogeomorphic Ecosystem Engineers (BEEs) in the Devonian, the period when vascular plants, trees and forests first emerged.

MAIN GLOBAL EVENTS IN THE DEVONIAN RELATED TO VASCULAR PLANTS AND TREES



Pawlik et al., ESR, submitted. The figure based on data from Foster et al. (2017).



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Table 1. Climatic trends in the Phanerozoic forced by global tectonics and plant evolution.

Triggering factor	Direct effect	Climate response	Reference
1. latitudinal position of the continents	1. increase in CO ₂ consumption by silicate weathering when continents were in low latitude position	1. climate cooling	1. Godd��ris et al., 2014
2. land mass homogeneity - supercontinents vs. small continents	2. arid conditions associated with supercontinents weaken silicate weathering thus promoting high levels of pCO ₂	2. climate warming	2. Macdonald et al., 2019
3. arc-continent collisions in the tropics and orogeny	3. increase global weatherability, CO ₂ decline	3. climate cooling	3. Macdonald et al., 2019
4. tectonics and mountain uplift	4. regolith removal by erosion and increase in chemical weathering	4. climate cooling	4. Godd��ris et al., 2017
5. evolution of land plants	5. global modification of albedo, temperature, precipitation, and air circulation (the influence of surface roughness)	5. climate cooling	5. Boyce and Lee, 2017



SUMMARY

We argue that trees are effective biogeomorphic ecosystem engineers currently. However, we find only two pieces of evidence (supported by geological evidence) to allow similar conclusion regarding Devonian trees (or tree-like plants): 1) co-evolution with river systems from braided to meandering, and 2) co-evolution with new soil types.

SUMMARY

- Trees may be considered as biogeomorphic ecosystem engineers.
- The scope of Devonian trees impact on weathering and soil production is still uncertain.
- Biogeomorphic Ecosystem Engineering concept can support Devonian Plant Hypothesis.
- New geochemical and isotopic data support abiotic origin of many global events during the Devonian.

THANK YOU FOR YOUR ATTENTION!

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