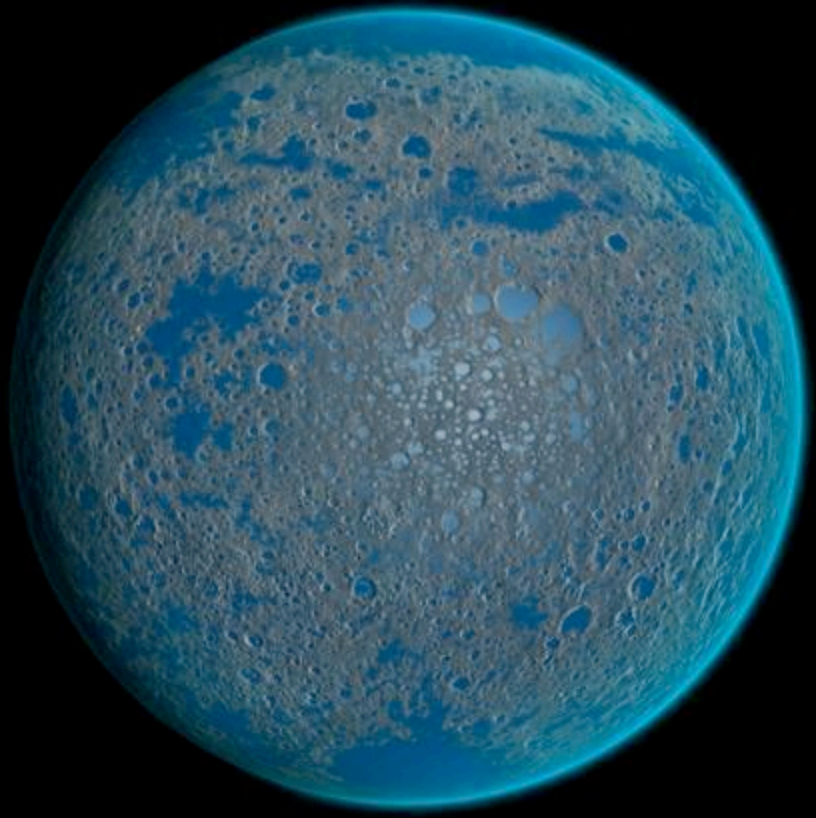
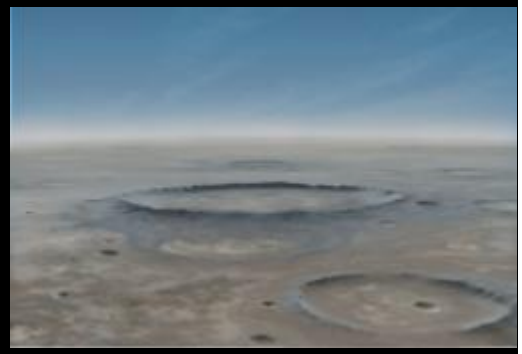
Mawrth Vallis

preserving the origins

Conclusion

Mawrth Vallis is Unique in its Relevance for MSL Goals





J-P. Bibring, J. Bishop, J. Carter, B. Ehlmann, D. Loizeau, N. Mangold, N. McKeown, J. Michalski, J. Mustard, E. Noe Dobrea, M. Parente, F. Poulet, J. Wray

Conclusion

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Since Viking, what has changed?

→ The (astrobiological) goals are essentially similar

- impressive improvement of capabilities and performances of the roving system and of its instrument suite

- profound revisiting of Mars History

→ It exhibits an era of potential habitability, with sustained liquid water, recorded in specific hydrated minerals.

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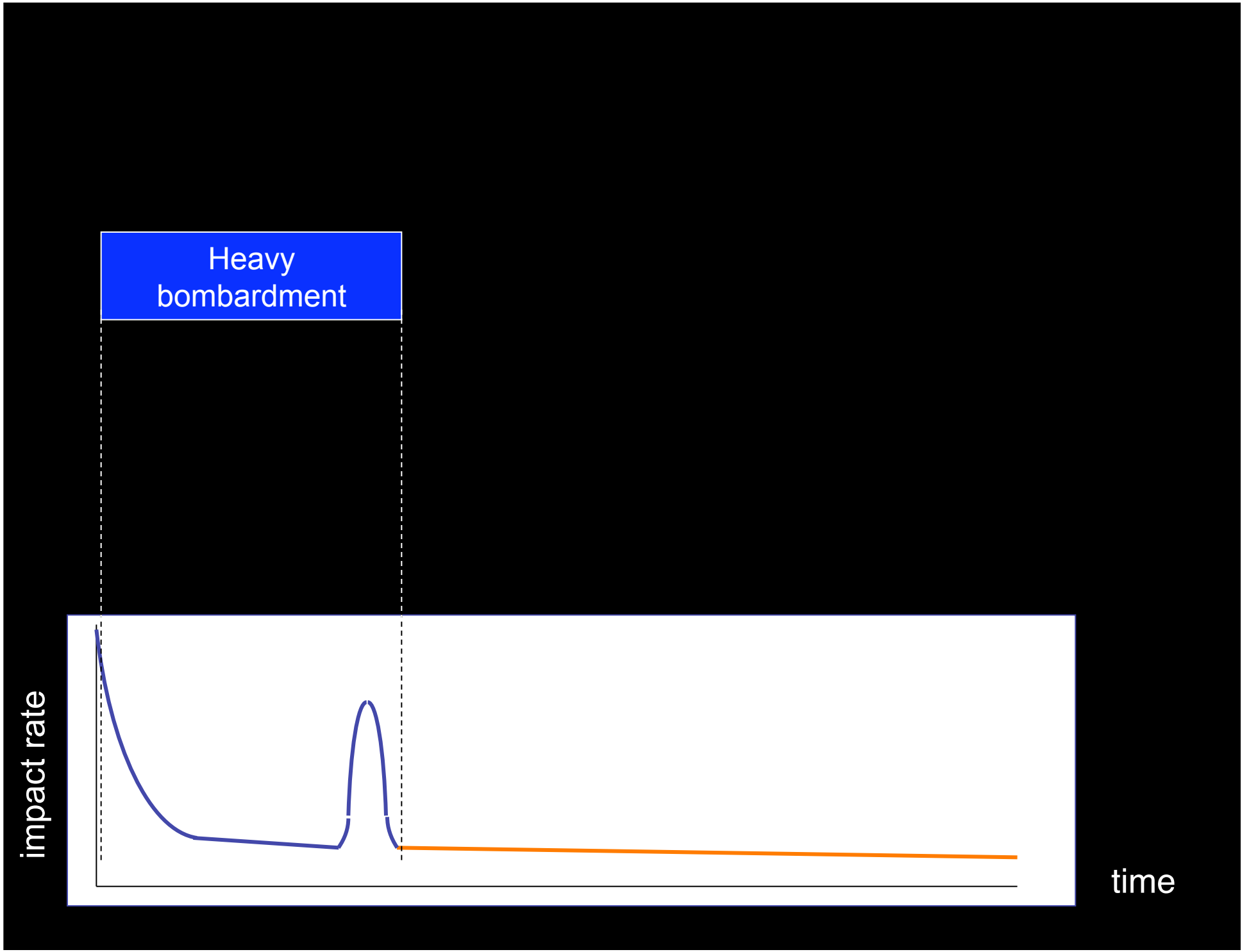
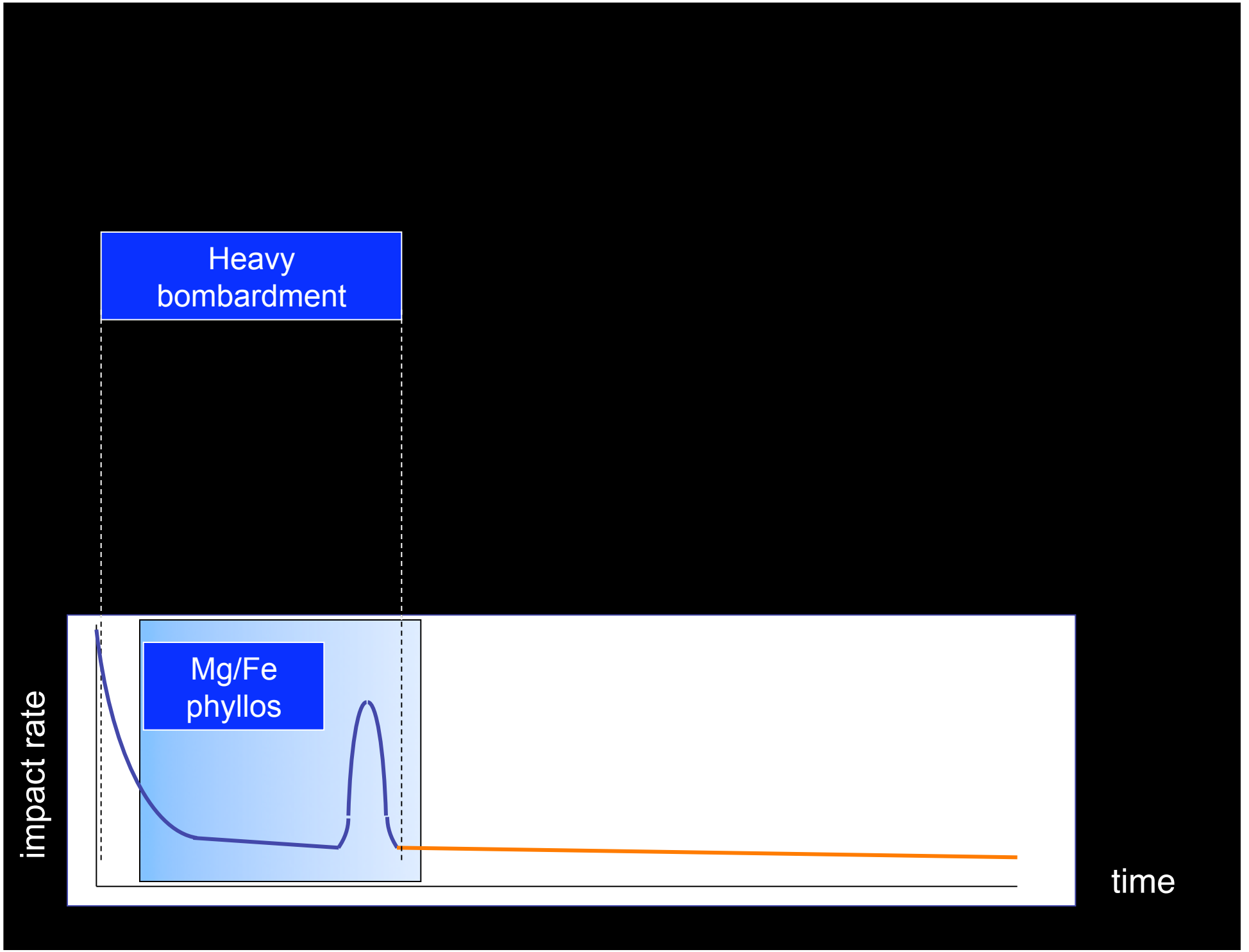
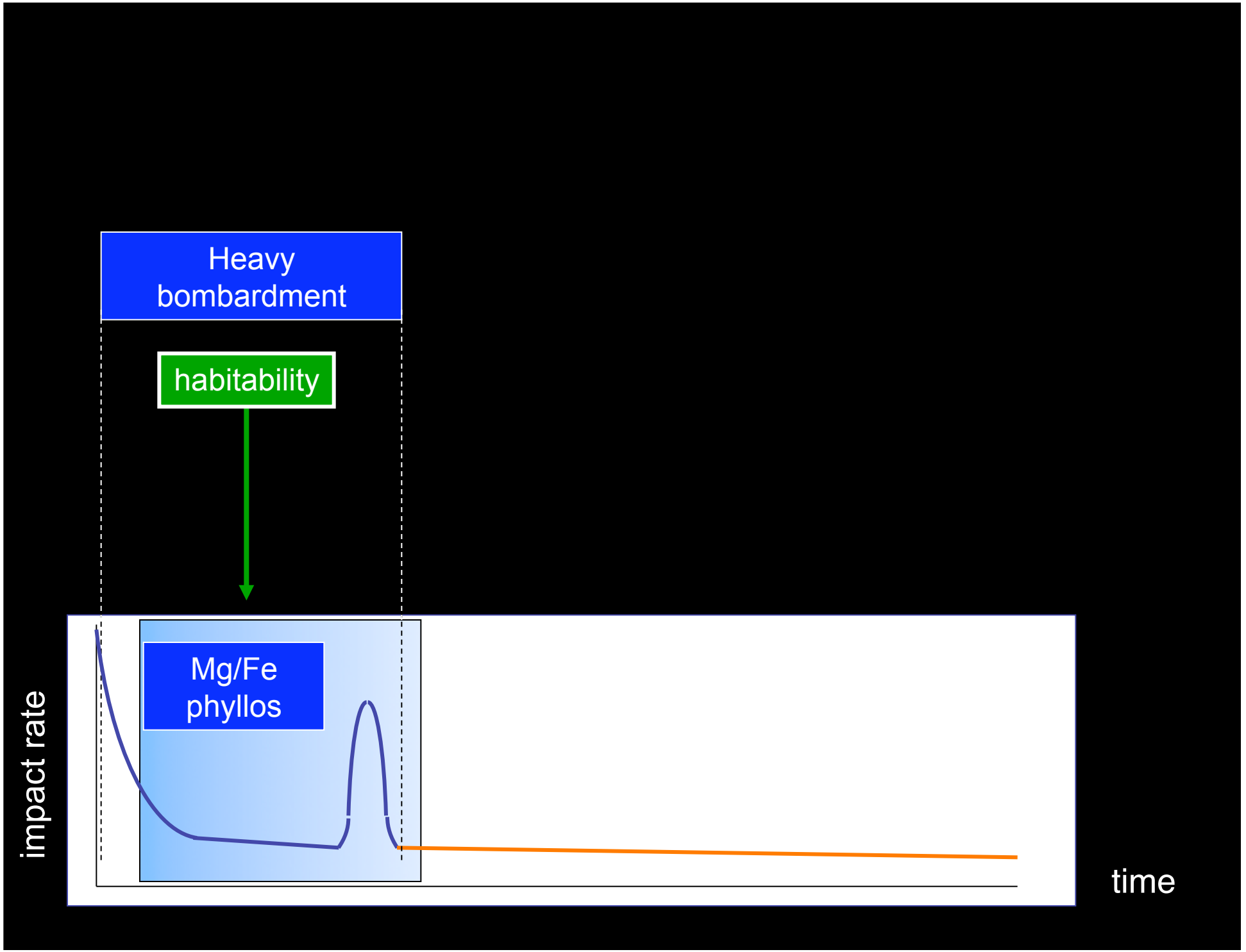
Sites recording this era exist.
They are extremely rare, to have remained in their original context.


Heavy bombardment
impact rate
time


Heavy bombardment
Mg/Fe phyllos
impact rate
time


Heavy bombardment
habitability
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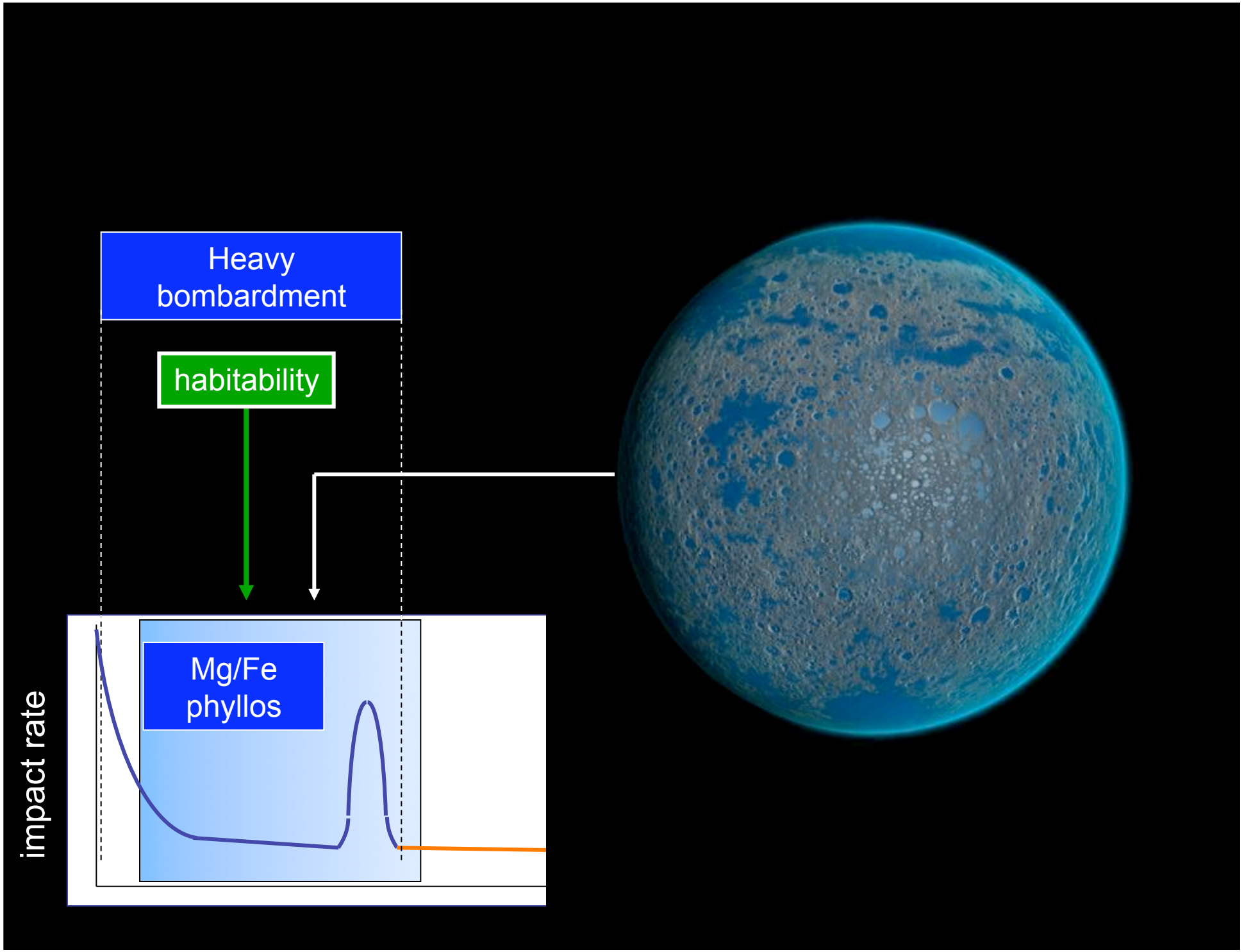
Heavy bombardment
habitability
Mg/Fe phyllos
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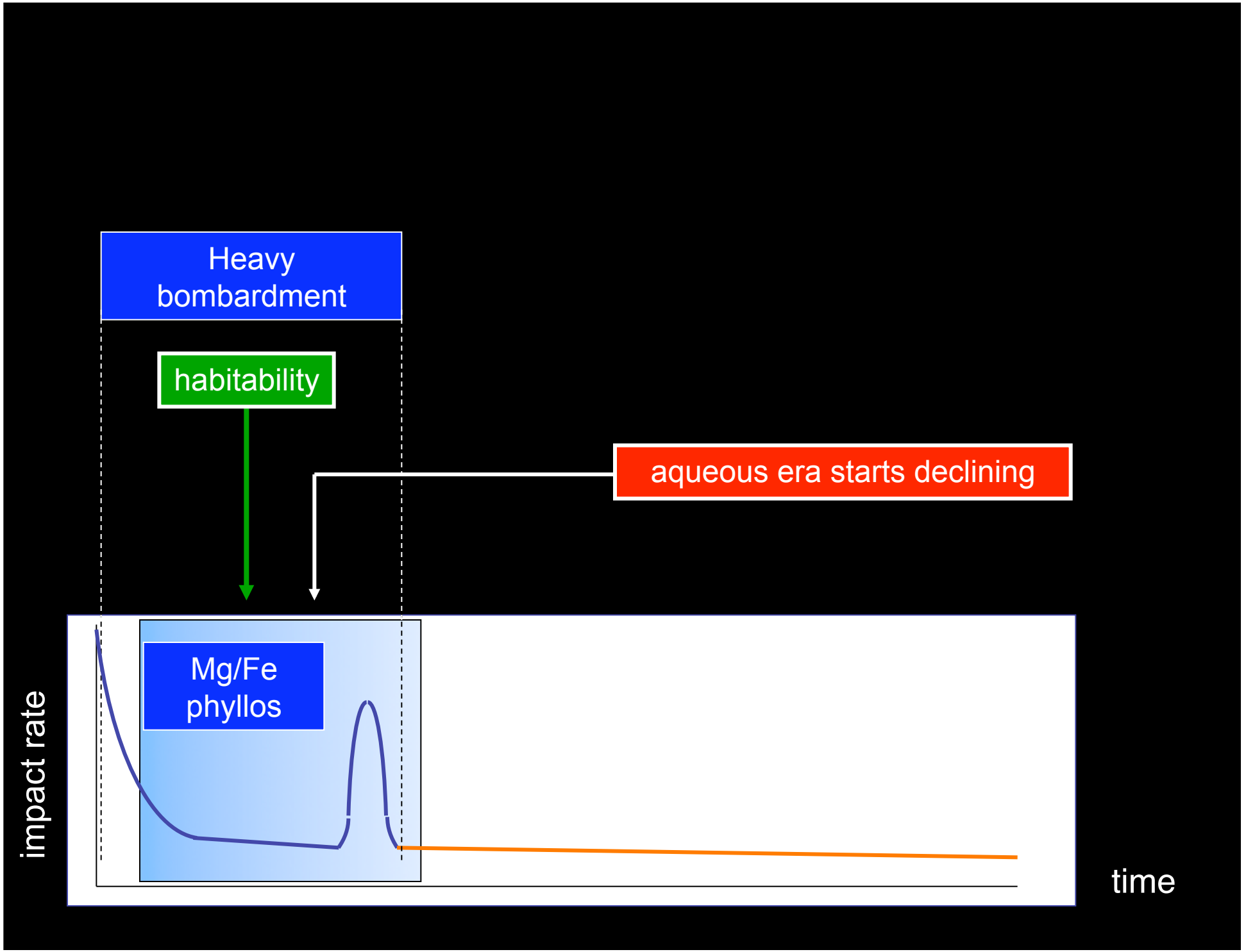
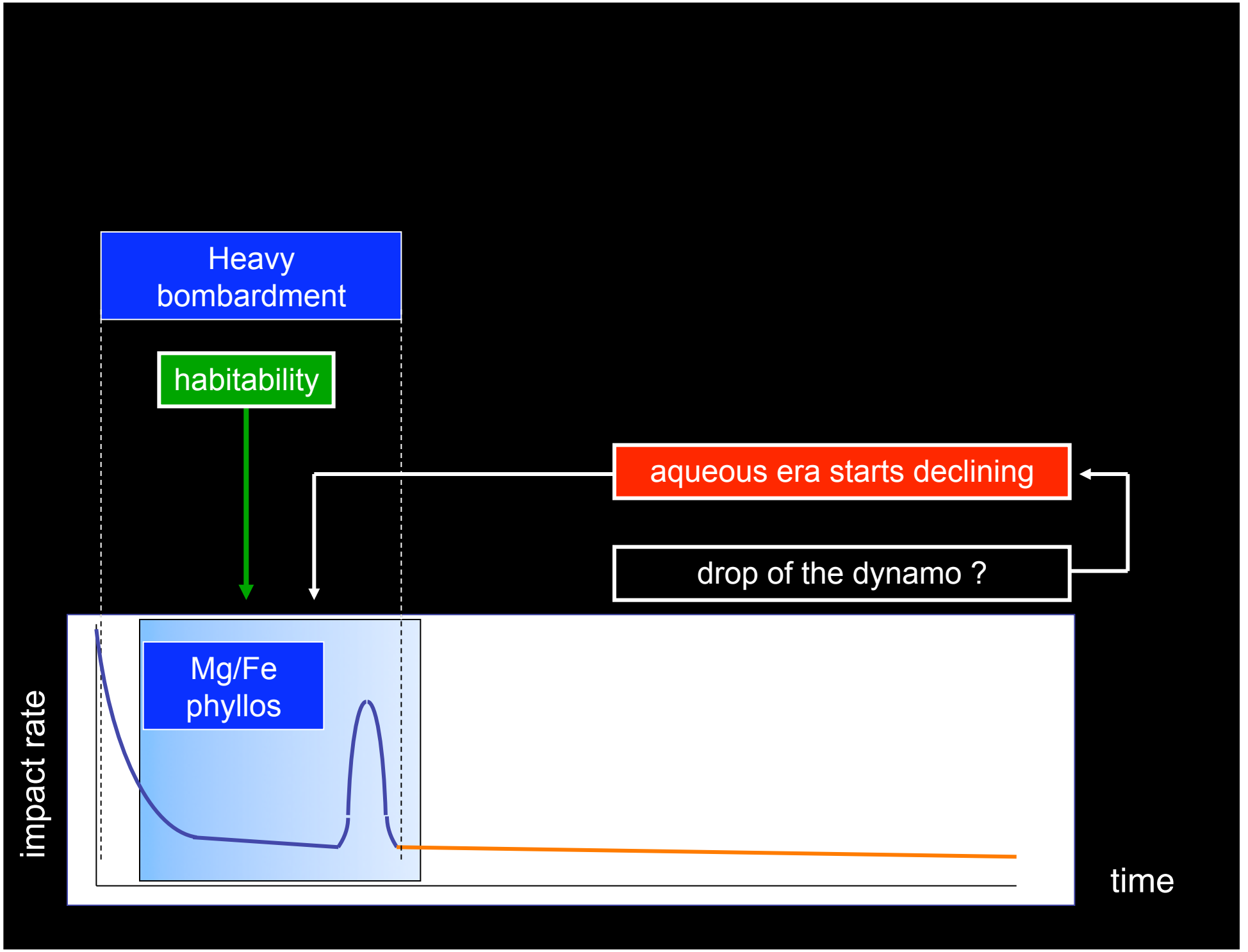
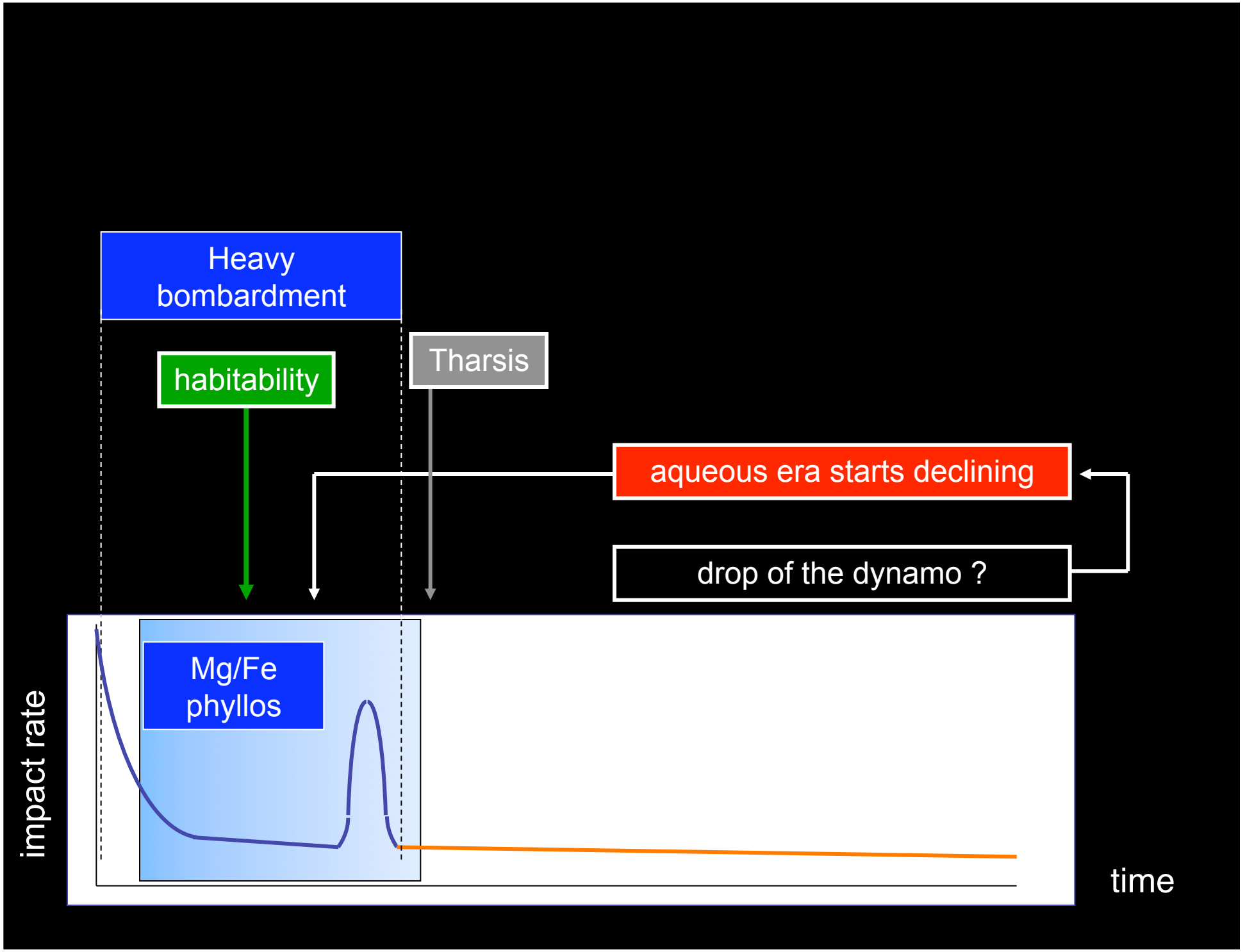

Heavy bombardment
habitability
aqueous era starts declining
Mg/Fe phyllos
impact rate
time


Heavy bombardment
habitability
aqueous era starts declining
drop of the dynamo ?
Mg/Fe phyllos
impact rate
time


Heavy bombardment
habitability
Tharsis
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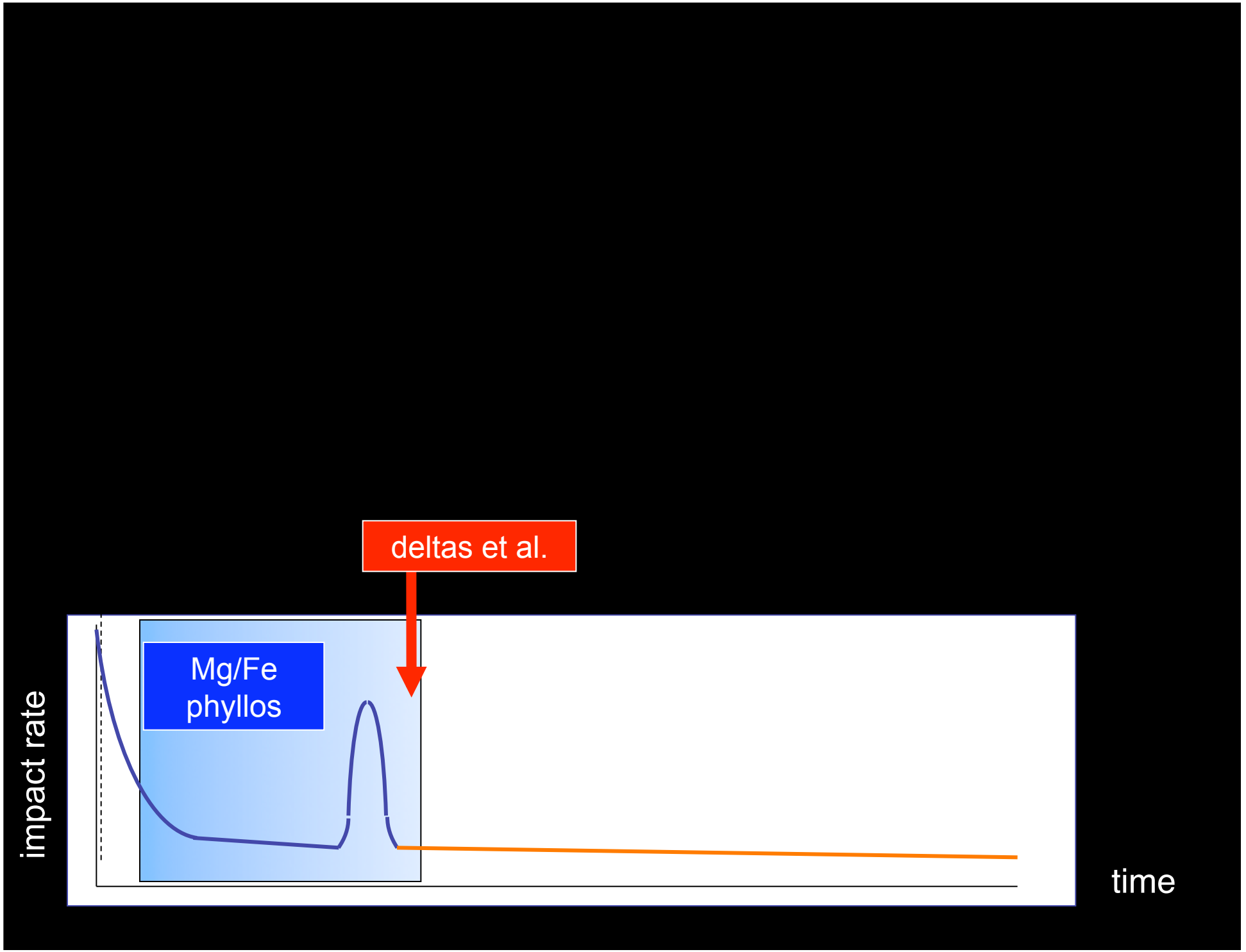
deltas et al.
Mg/Fe
phyllos
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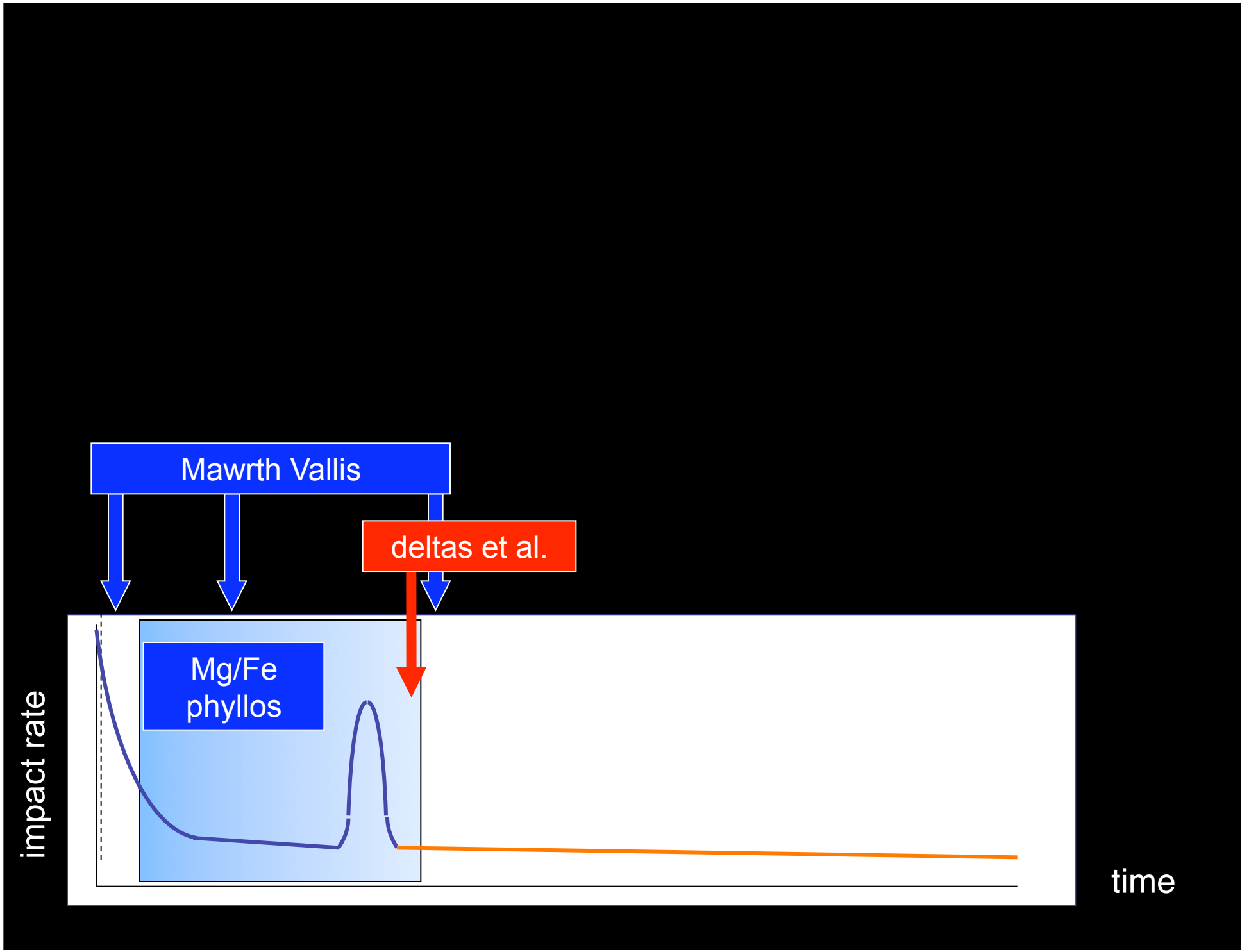
Mawrth Vallis
deltas et al.
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impact rate
time

Conclusion

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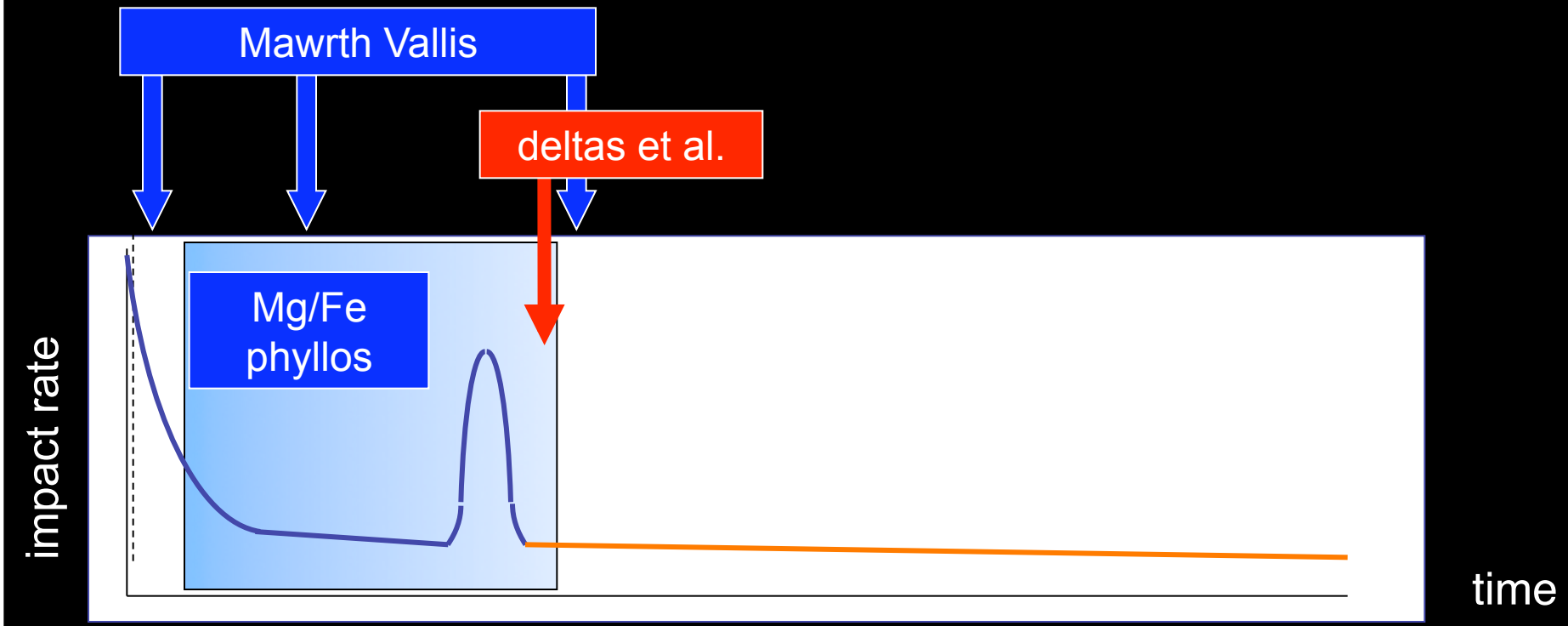

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Mawrth Vallis benefits from an unique history, thanks to which

- it has not been subjected to further global transport and/or transformation which would have erased the earlier events; still in place
- it still preserves the record of the processes and environment characterizing this critical era, during which life might have emerged
- it is by far the site with the larger abundance of phyllosilicates (> 50%)
- its size enables to locate a landing ellipse right on the spot (not a Go To)

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The interest of a not Go To site is not merely a matter of mission robustness and eager to feed curiosity. It also enables to return to this site with a lighter vehicle to re-examine samples with a distinct payload, then fetching samples to return to Earth. Mawrth Vallis fully fills this objective.

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- Mawrth Vallis thus exhibits an inherent geological complexity translating its uniqueness, to trace back an era never explored, with no equivalent (possibly in the entire solar system), but of utmost importance: during which life might have emerged. The deciphering of this record (processes, environment) constitutes the core of MSL goals.

Conclusion
Mawrth Vallis is Unique in its Relevance for MSL Goals

- However, we are far from going to the unknown in Mawrth Vallis. The impressive data sets acquired up to now demonstrate that exploring the Mawrth Vallis site will allow for access to most, if not all steps that paved the evolution of Mars along its first billion years, including its early potential habitable era.

- Mars' environment evolved drastically along this early period. Mawrth Vallis (only) allows following and characterizing this evolution. Analyzing samples from discrete layers with distinct mineralogies (alteration phases), retained in their original context, crustal rocks from nearby impacts, and other mafics (all in the landing ellipse) will give access to the sequence of processes that took place in a period never explored.

- We will sample material crystallized while the dynamo was active, until it faded out. We will analyze samples formed while the environment changed from alkaline to acidic, from a dense to a tenuous atmosphere.

- We will be able to couple the synthesis of potential C-rich compounds to a given environment, and decipher the key processes and/or ingredients that favored/ triggered this evolved chemistry.

- Mawrth Vallis presents a high degree of diversity in both mineralogy and geology. translating the diversity of steps of Mars evolution. The uniqueness of Mawrth Vallis is to preserve their context, enabling to retrieve the History.

Conclusion

Mawrth Vallis is Unique in its Relevance for MSL Goals

- If life emerged (other than on the Earth), these rocks are the most favorable to have recorded bio-relics (clays as efficient bio-harbours).

- Preservation: the extremely high abundances of hydrated phyllosilicates (in particular of nontronite) and other hydrated phases at Mawrth Vallis, demonstrate that, although they formed more then 4 billion years ago, they were not subjected to further major desiccation / alteration (e.g. through diagenesis) process: potential C-rich trapped compounds would have been well preserved.

- It is remarkable that the evolution of Mars has preserved such a site, with properties and in a context exemplary of most ancient Mars surface.

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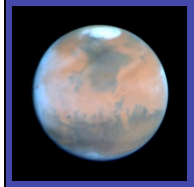
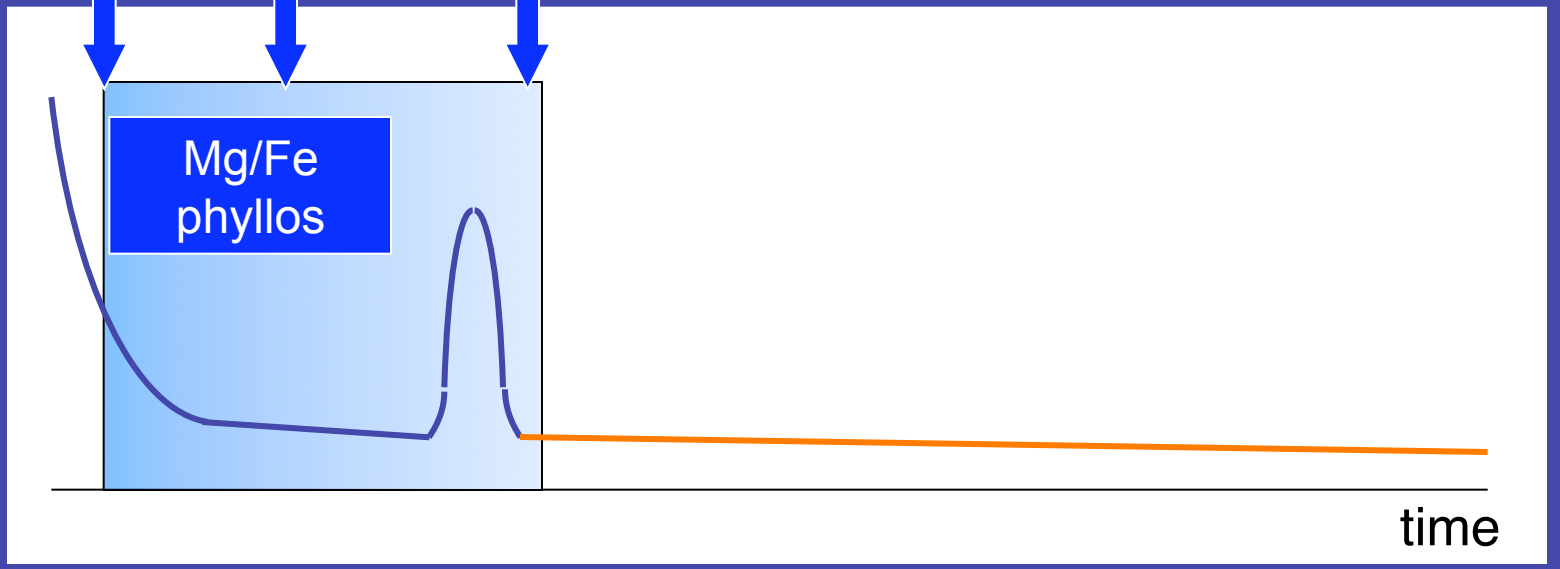
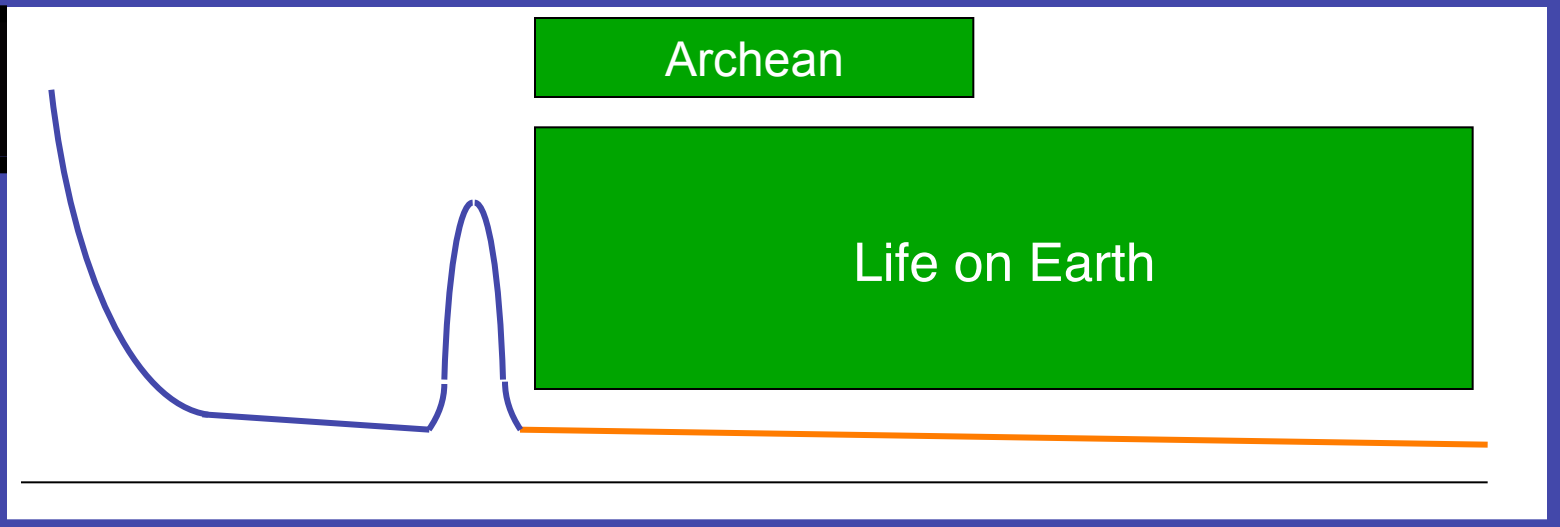
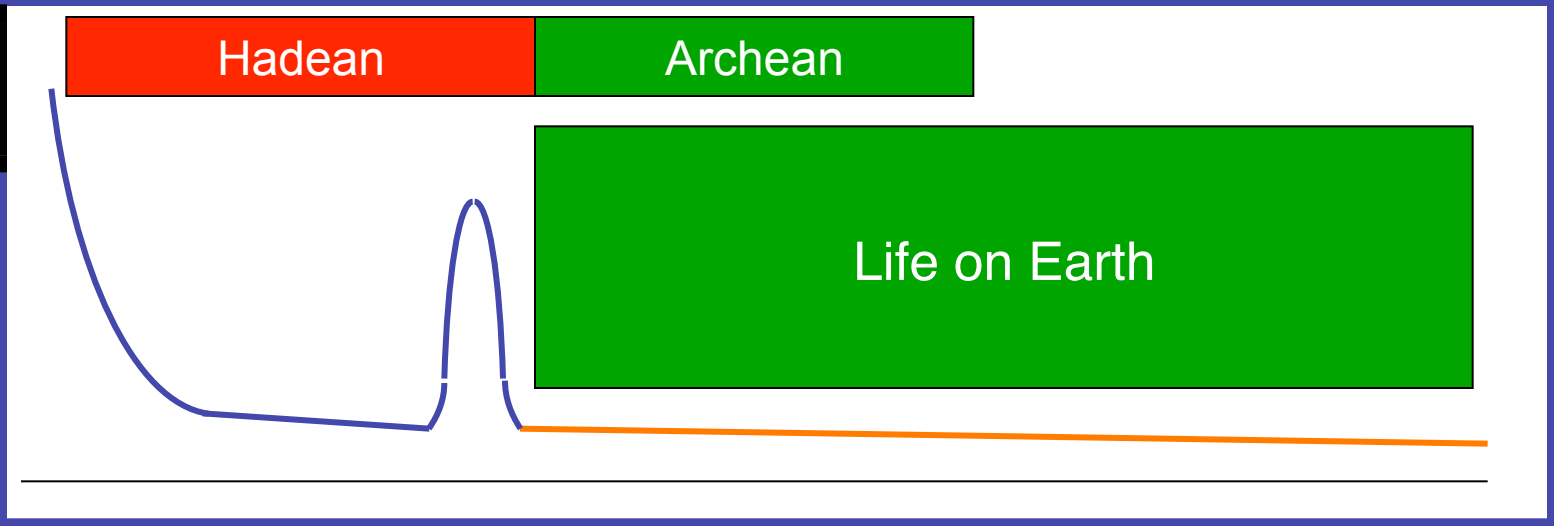
- The interest of exploring Mawrth Vallis goes beyond Mars




Mawrth Vallis
Mg/Fe
phyllos
impact rate
time


Archean
Life on Earth


Hadean
Archean
Life on Earth

impacts often considered sterilizers

heavy bombardment

Hadean

Archean

Life on Earth

impacts often considered sterilizers → on Earth as on Mars

heavy bombardment

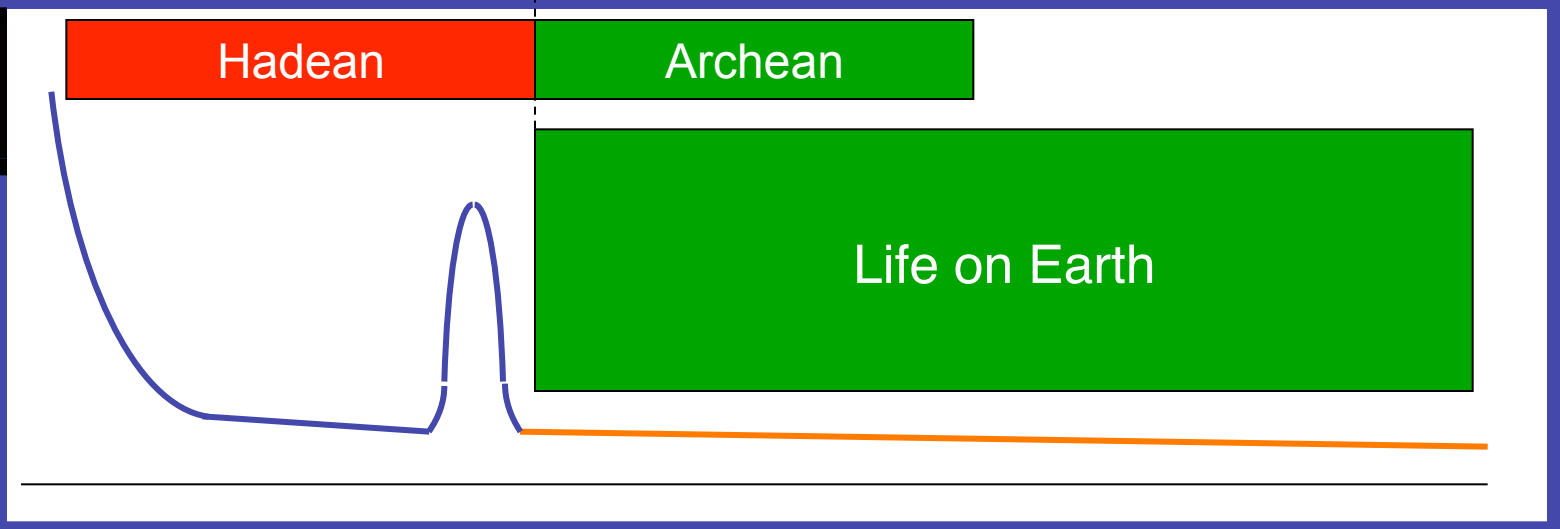
Hadean | Archean

Life on Earth

impacts often considered sterilizers → on Earth as on Mars

heavy bombardment

both questionable!



Was the Earth habitable / inhabited earlier ?

?

Life on Earth

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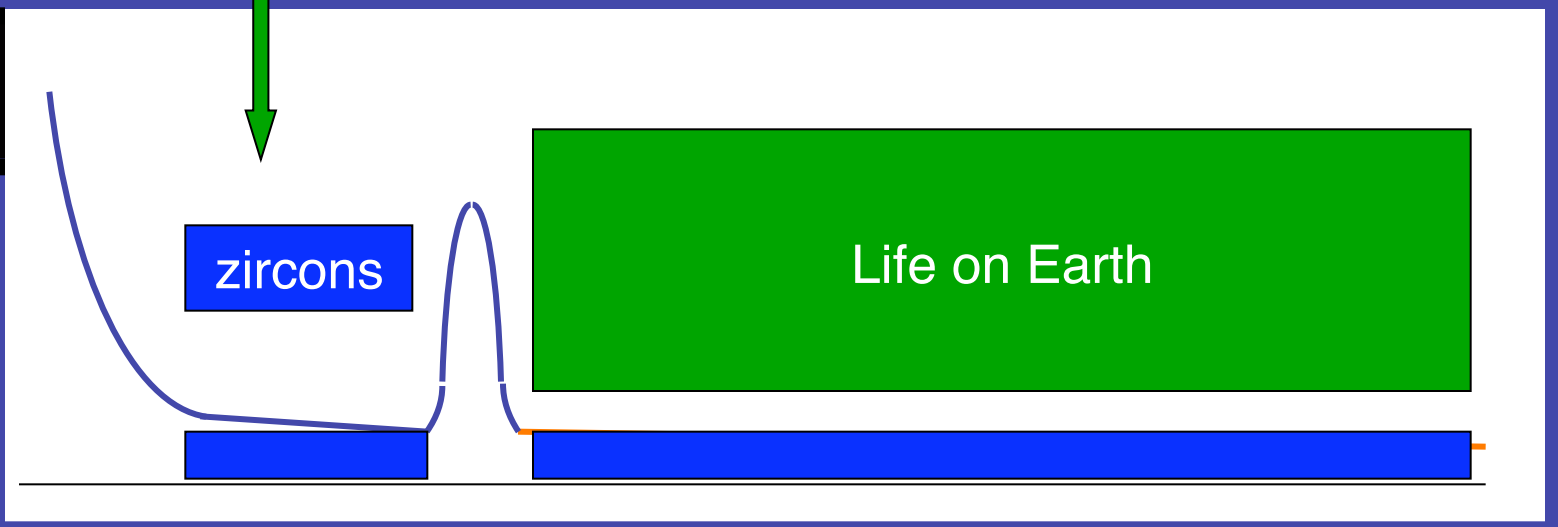

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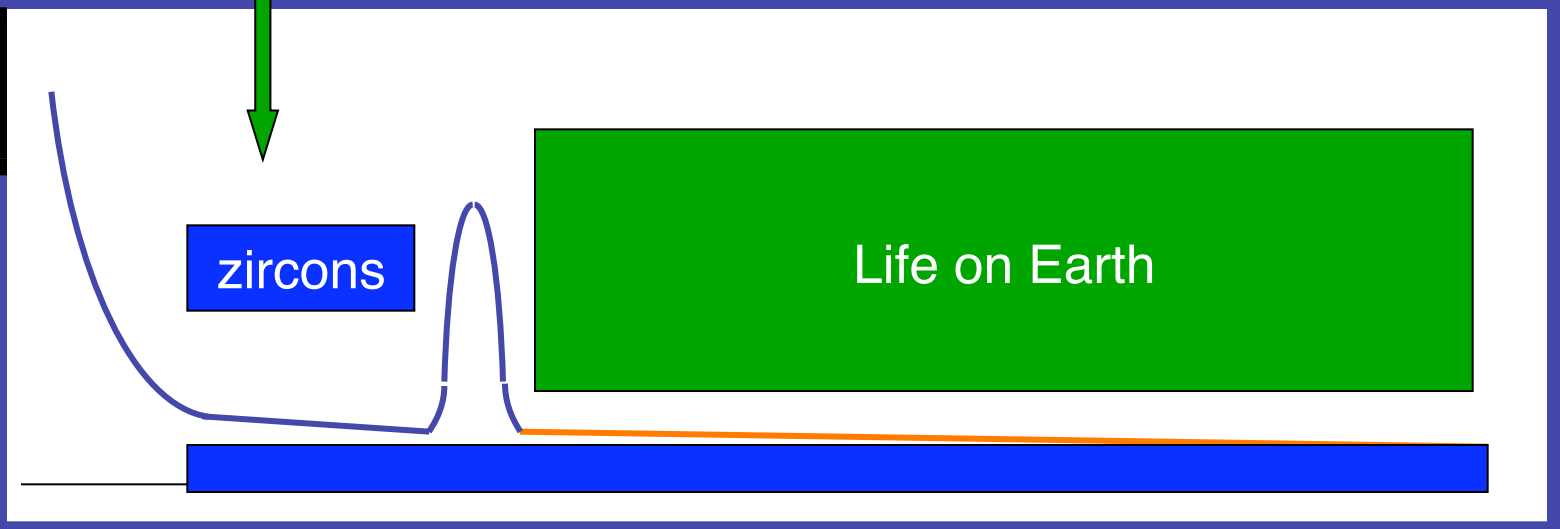
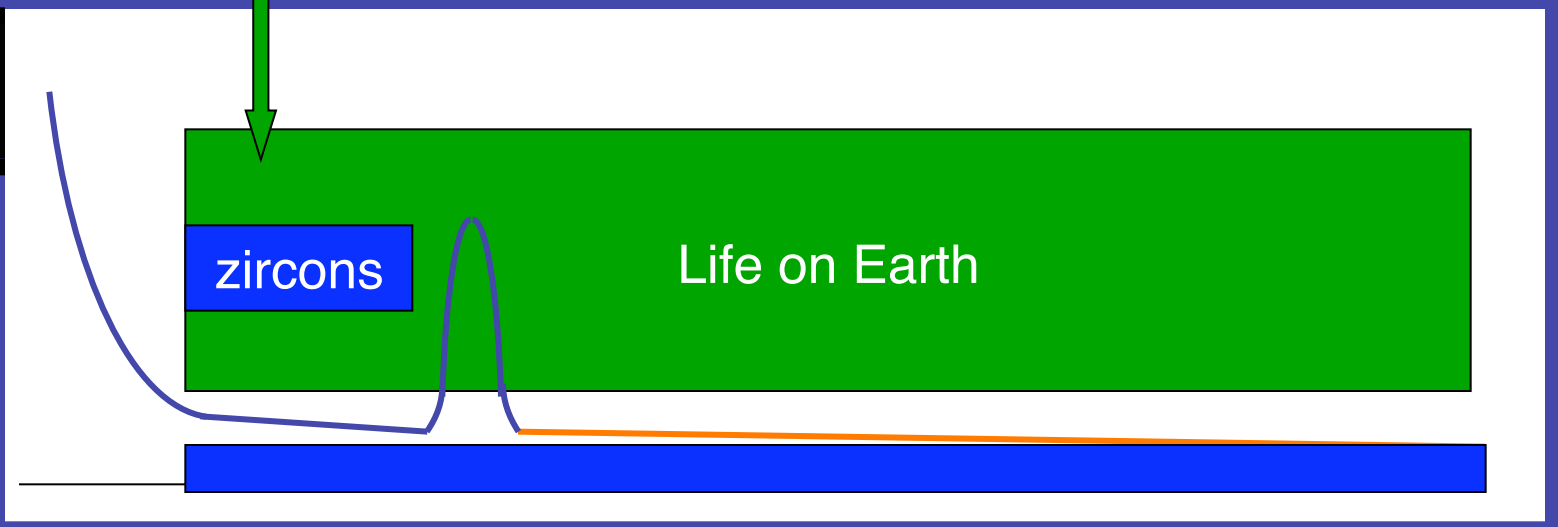
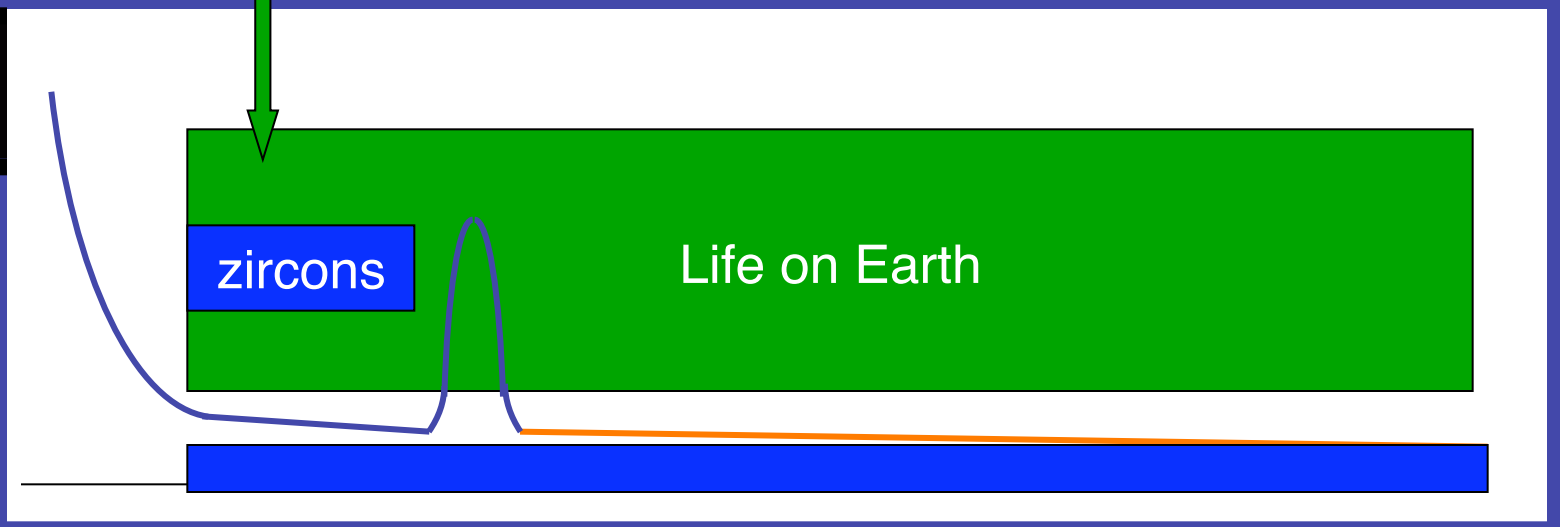


Did life emerge early ? More and more likely.



Did life emerge early ? More and more likely. How ?



Mars might have the answer

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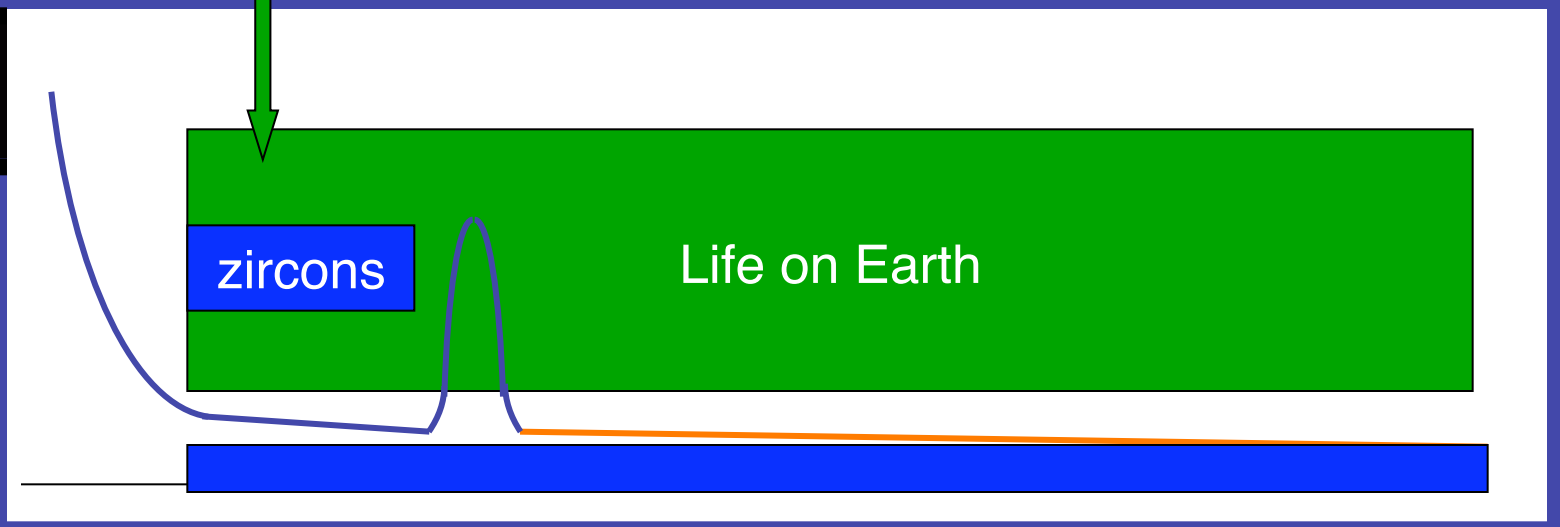
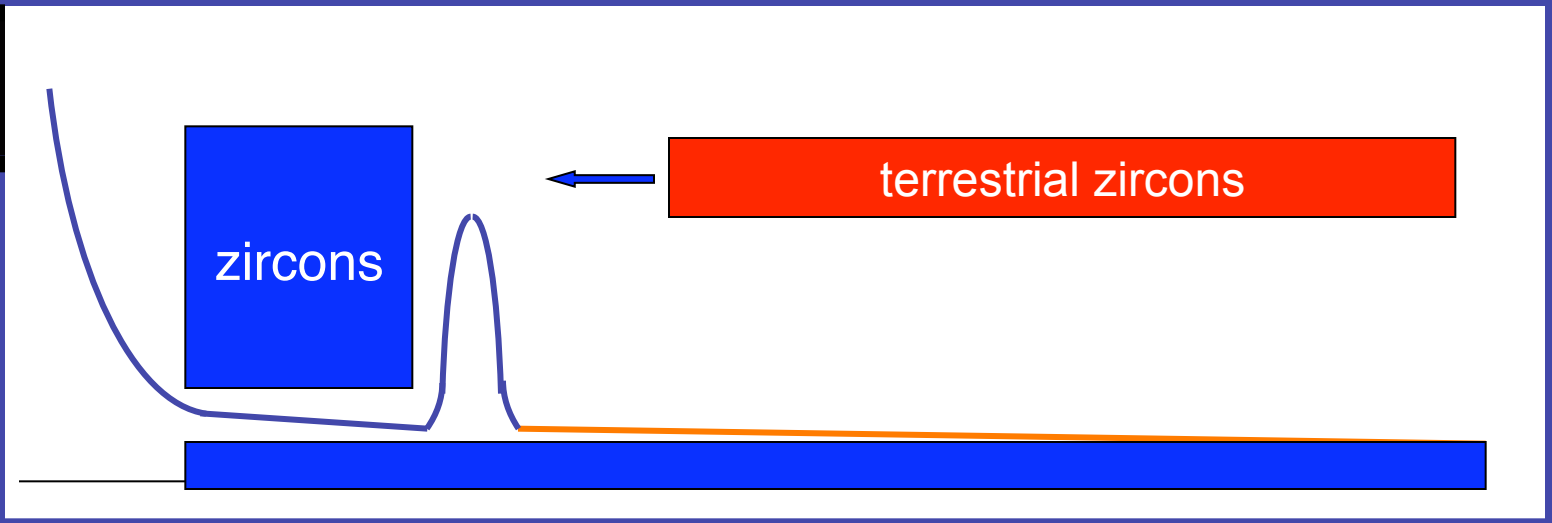
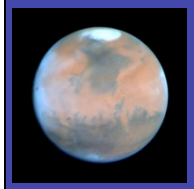



zircons
terrestrial zircons



Mg/Fe Phyllos

Al/Si phyllos

Martian phyllosilicates

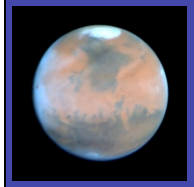
impact rate

time

play analogous roles

zircons

terrestrial zircons



Mg/Fe Phyllos

Al/Si phyllos

Martian phyllosilicates

the context is well preserved

impact rate

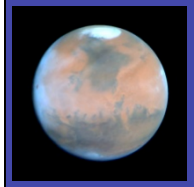
time

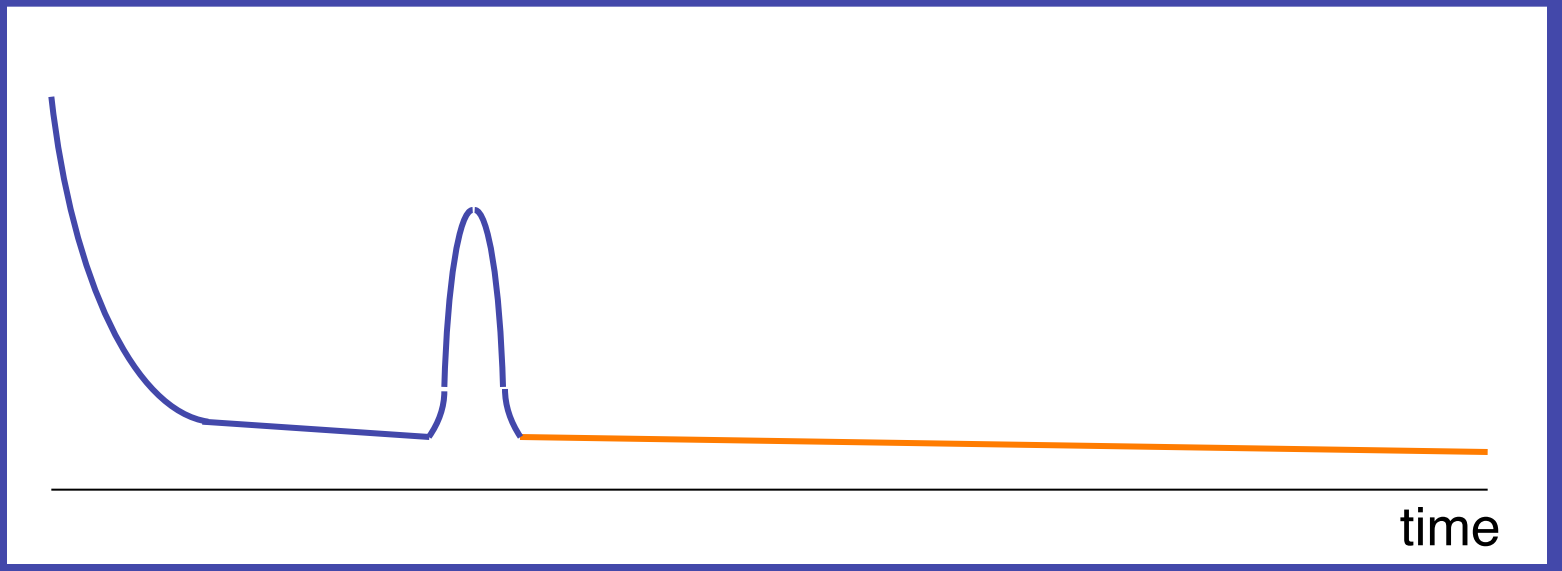
play analogous roles

zircons

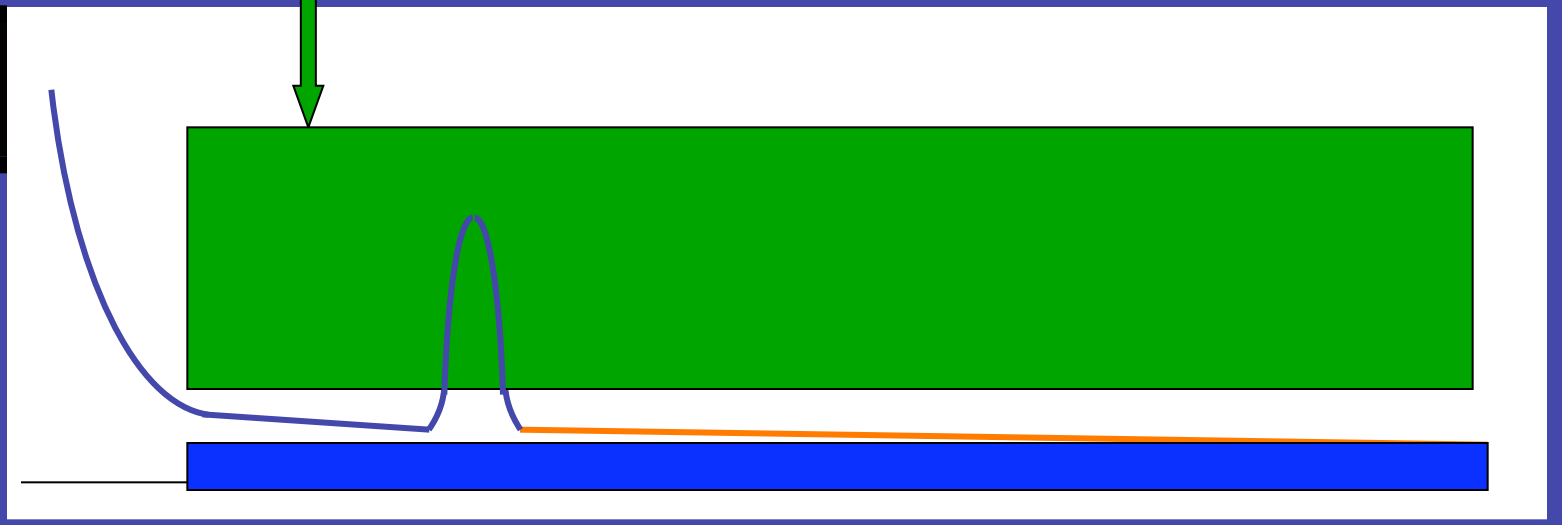
terrestrial zircons

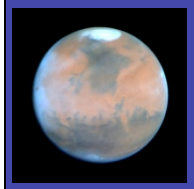
the context is entirely lost





Did life emerge early ? How ?



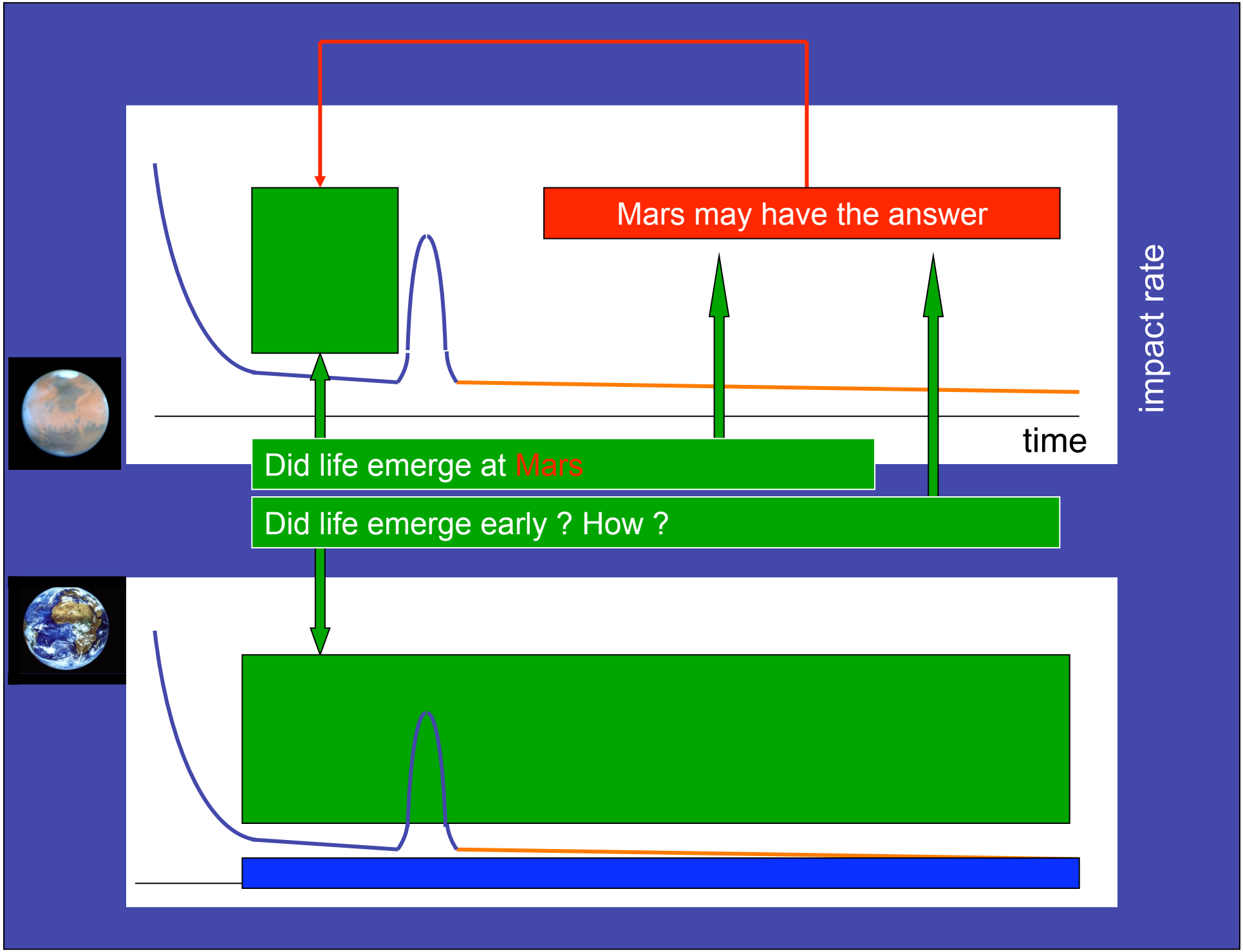


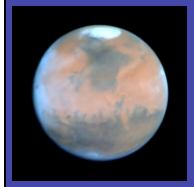
impact rate

time

Did life emerge at Mars

Did life emerge early ? How ?

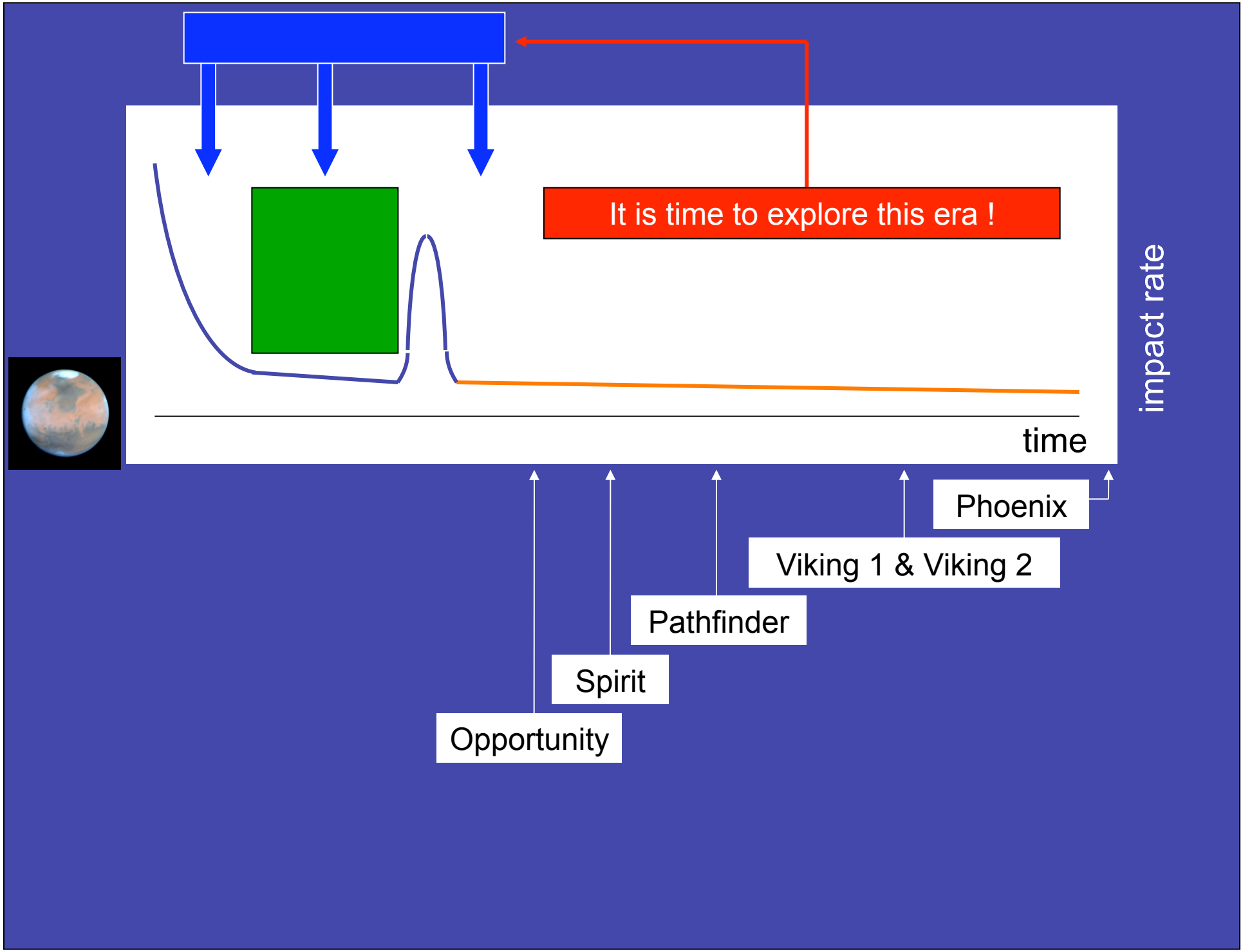

Mars may have the answer
impact rate
time
Did life emerge at Mars
Did life emerge early ? How ?



It is time to explore this era !

impact rate

time


It is time to explore this era !
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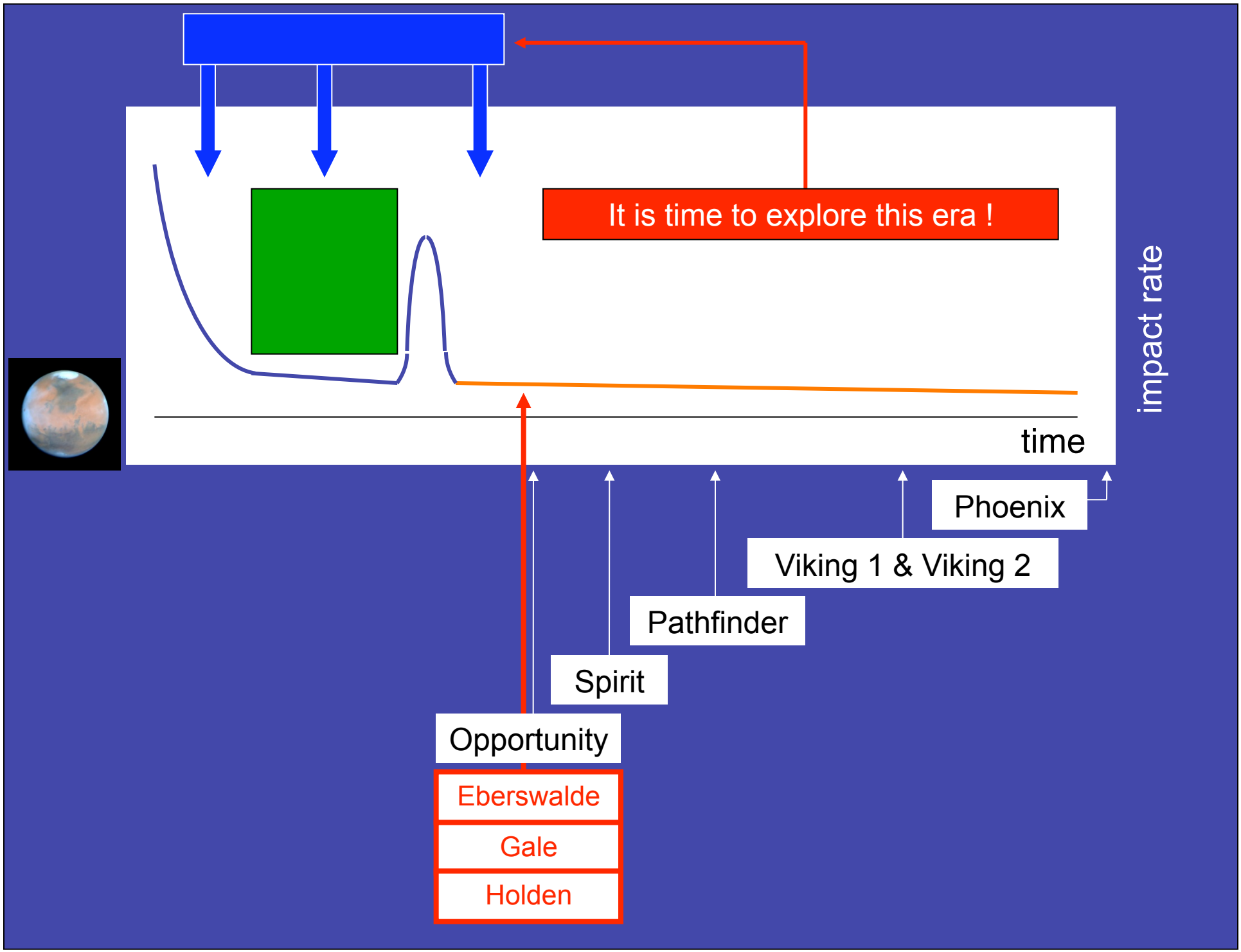
Pathfinder
Spirit
Opportunity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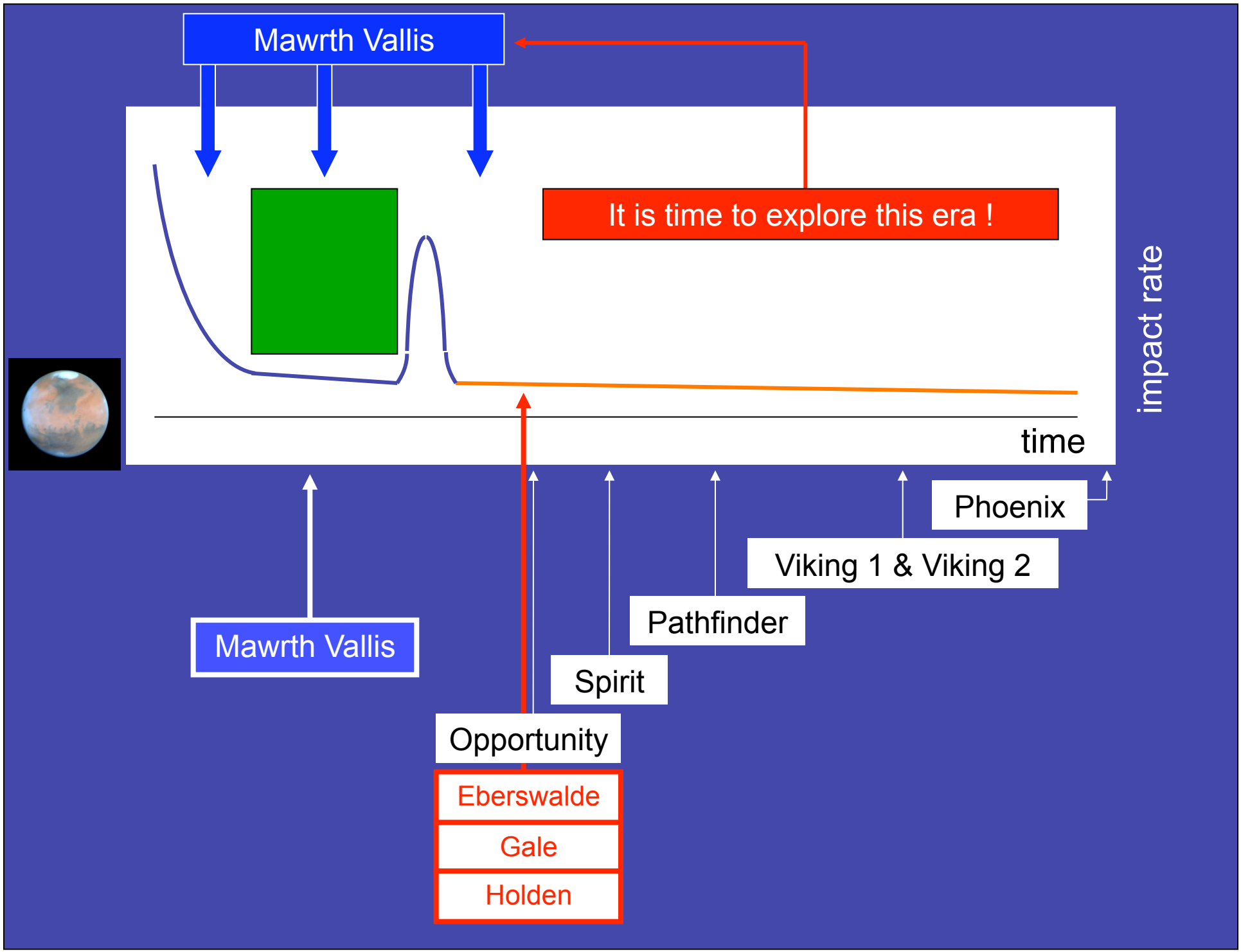
Mawrth Vallis
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Conclusion

Mawrth Vallis is Unique in its Relevance for MSL Goals

Exploring Mawrth Vallis will constitute a fascinating journey, from the day of MSL touchdown.

Each new day will procure new excitements, and discoveries: day after day, we will turn the pages of the ancient Mars History, over hundreds of millions years, never explored before, and remained as it was, still in place, waiting for us to decipher it.

In particular if life ever emerged in the solar system other than on the Earth, Mawrth Vallis should have preserved its record, both as bio-relics, and with clear remnants of the relevant processes; clues of the divergent evolutionary pathways of Mars and the Earth will be offered. At Mawrth Vallis, astrobiology will truly enter its scientific era.

That Mars has preserved this site, maintaining the record of such critical events, results from a complex and very subtle suite of events, most of which are still not understood. The key point is: one should not miss the extraordinary chance we have, that this site exists, and that we have discovered it. No where else will the MSL goals be met at such a level. No where else shall we feed the scientific community, and far beyond, with excitements of truly unprecedented nature.