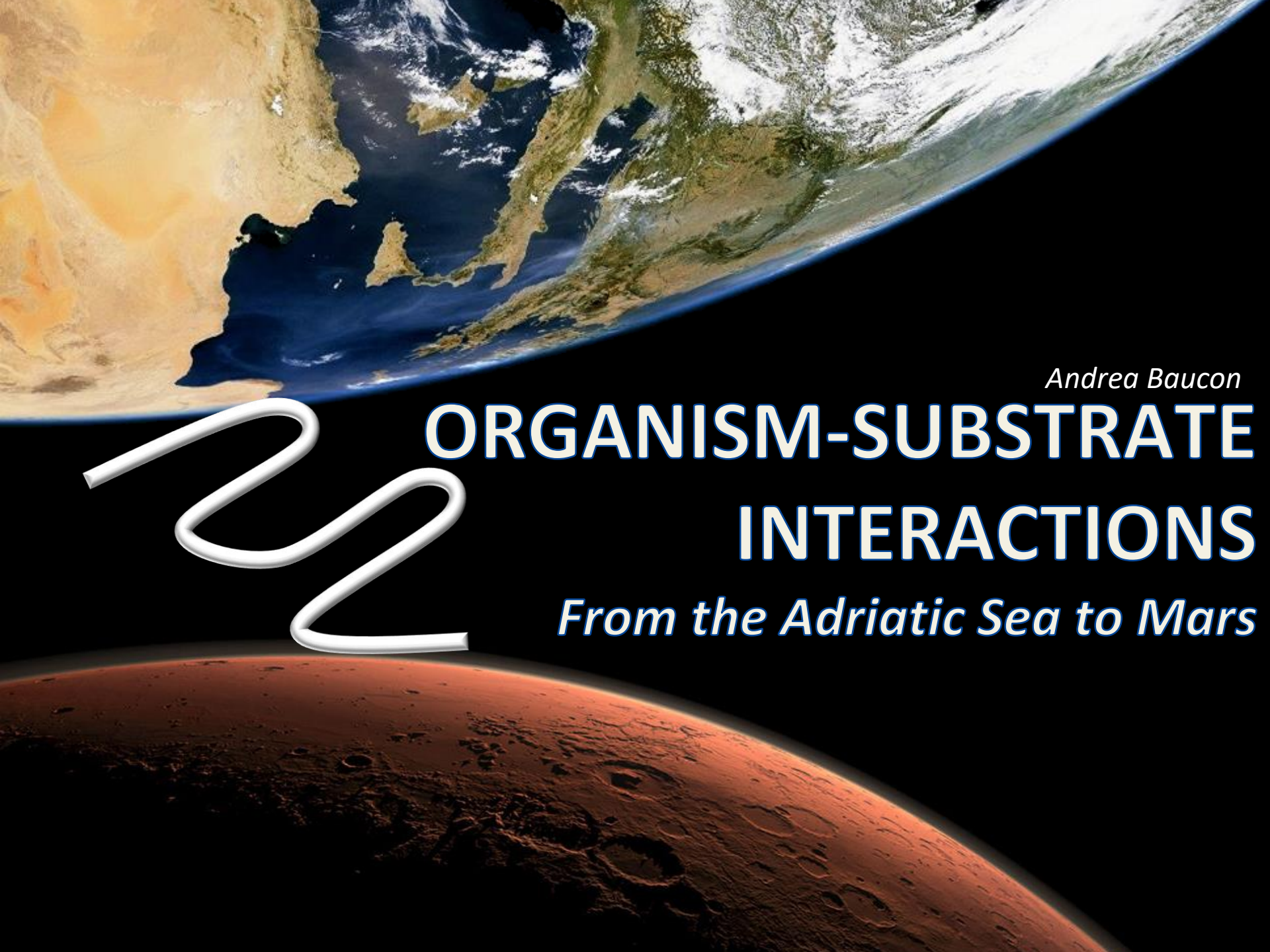
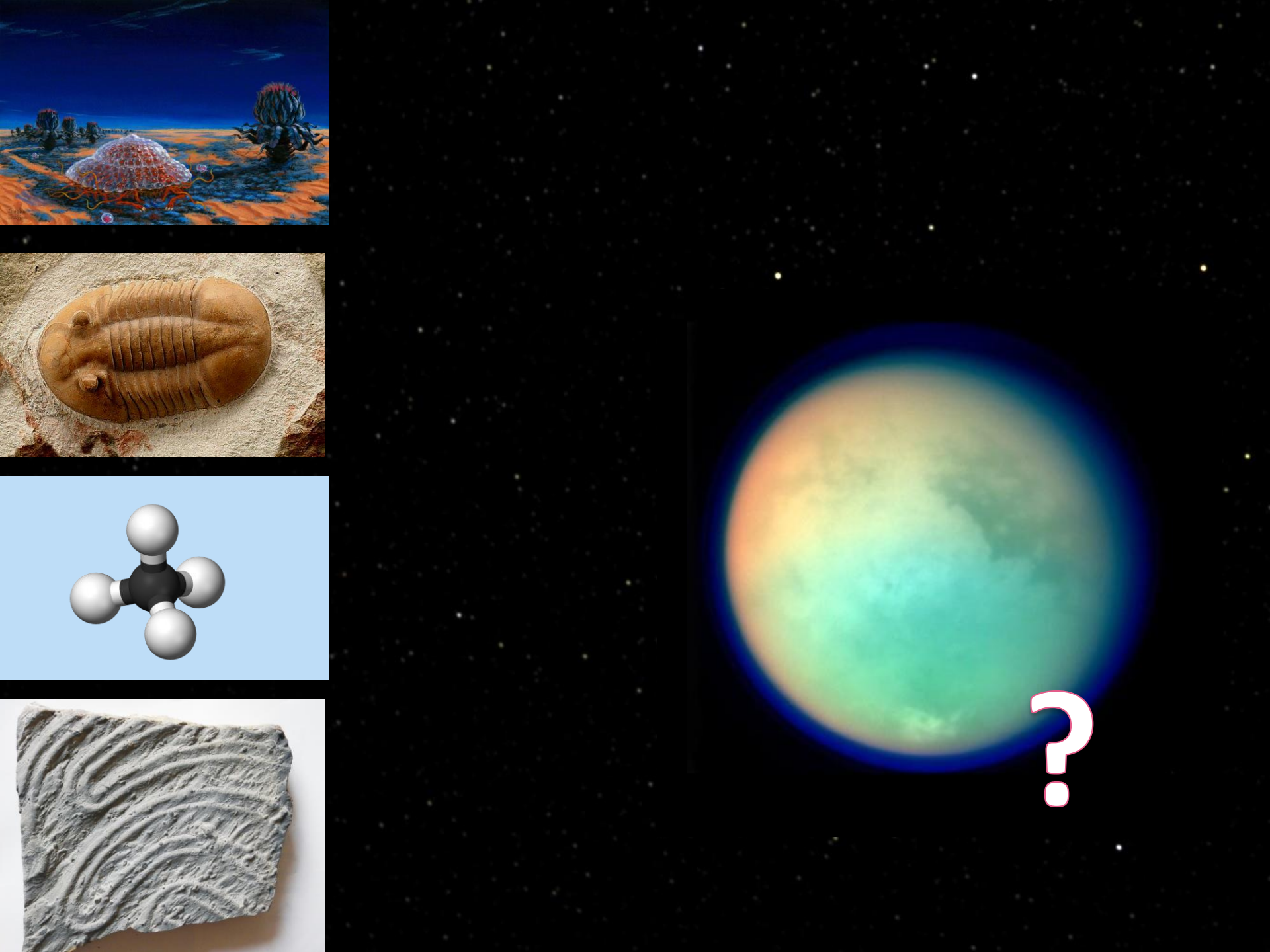


Andrea Baucon

ORGANISM-SUBSTRATE INTERACTIONS

From the Adriatic Sea to Mars



A «follow the trace» strategy

"Let's have [the Martian] find his way in the daytime by his little red tendrils and at night **he will dig a hole**."
—Carl Sagan in a letter to his editor, 1967

Body fossils are apparently a more direct evidence for life…

Trace fossil

Body fossil

The Adriatic: a privileged place

PRESENT

PAST (2.5 MYA)

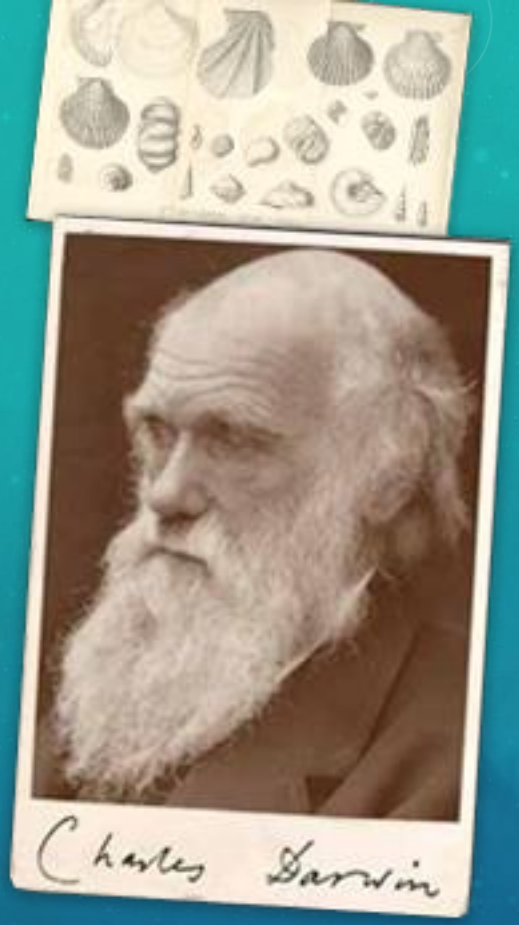
The Adriatic as an ‘alien’ sea

section 1

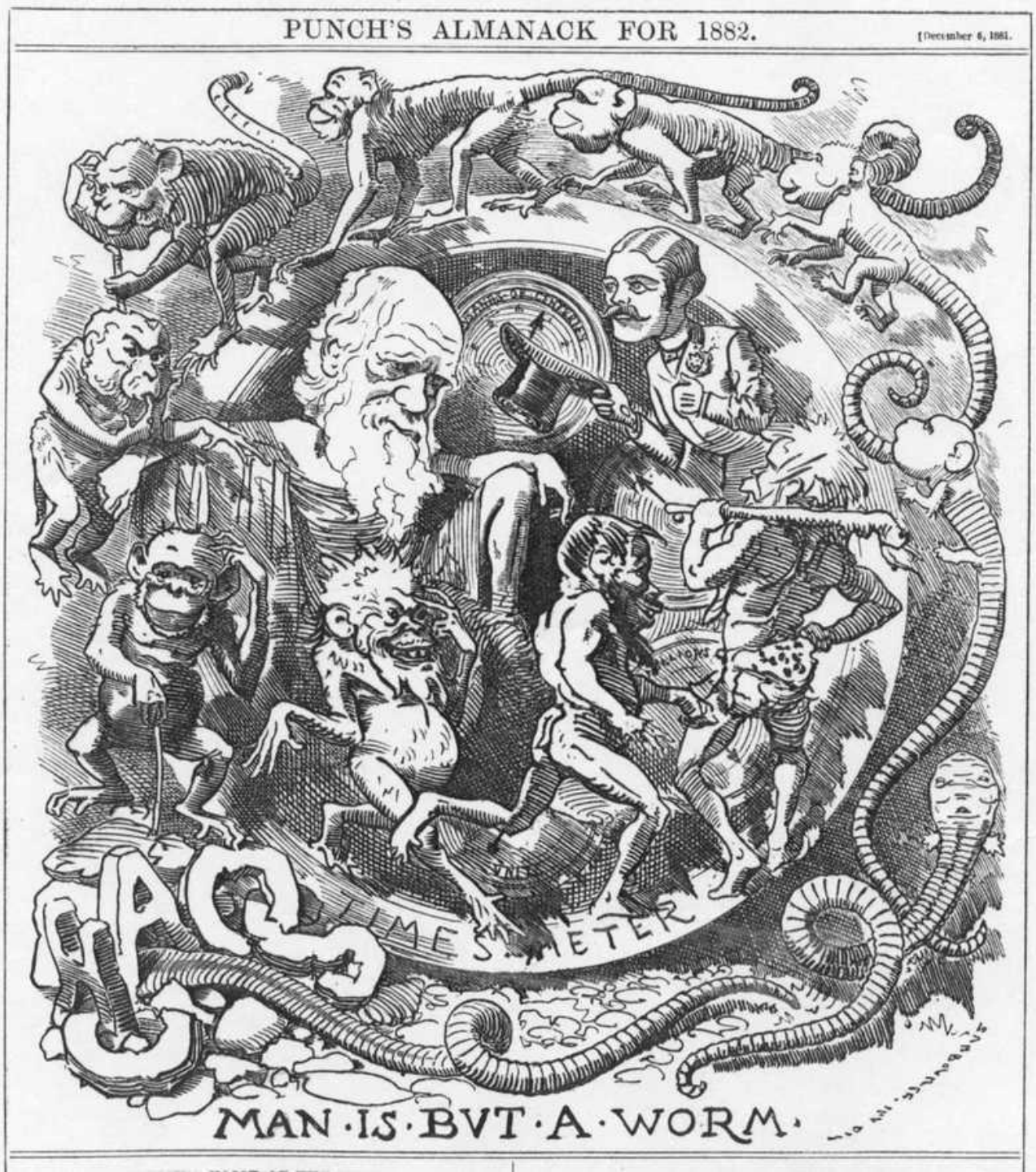
Traces are common


Neoproterozoic; Jensen (2003)


Mars; Noffke (2015)

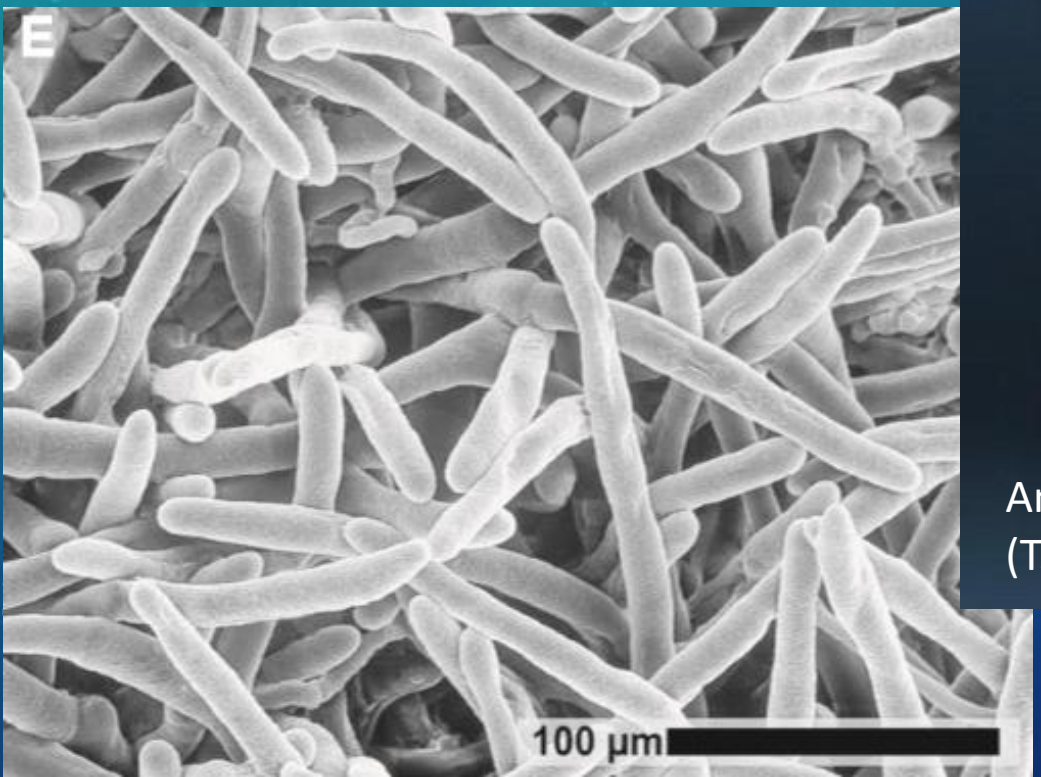


Life modifies its environment: why?



Burrows and borings are required to mantain homeostasis

This may hold also on other planets and moons!



Ant burrow cast
(Tschinkel, 2003)

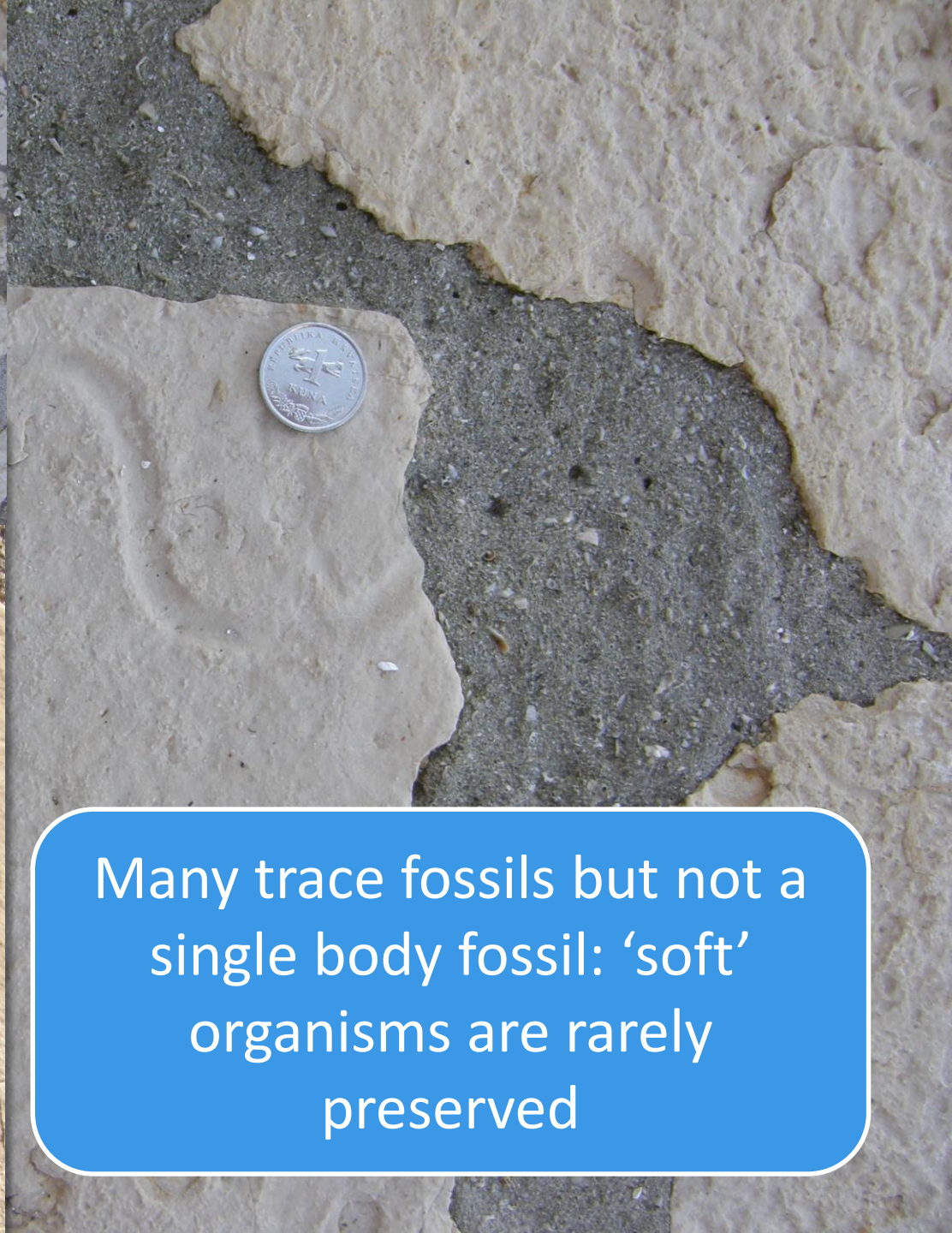
Epoxy cast of cyanobacteria boring;
(Whisshak et al., 2011)

Very scale-free: Mammal boring (Lopes et al., 2017)


Trace fossils of this hotel

Trace fossils at the hotel: echinoderm burrow


Trace fossils at the hotel:
‘worm’ burrow
REPUBLIKA HRVATSKA
KUNA



Many trace fossils but not a single body fossil: ‘soft’ organisms are rarely preserved

section 2

Traces are resilient

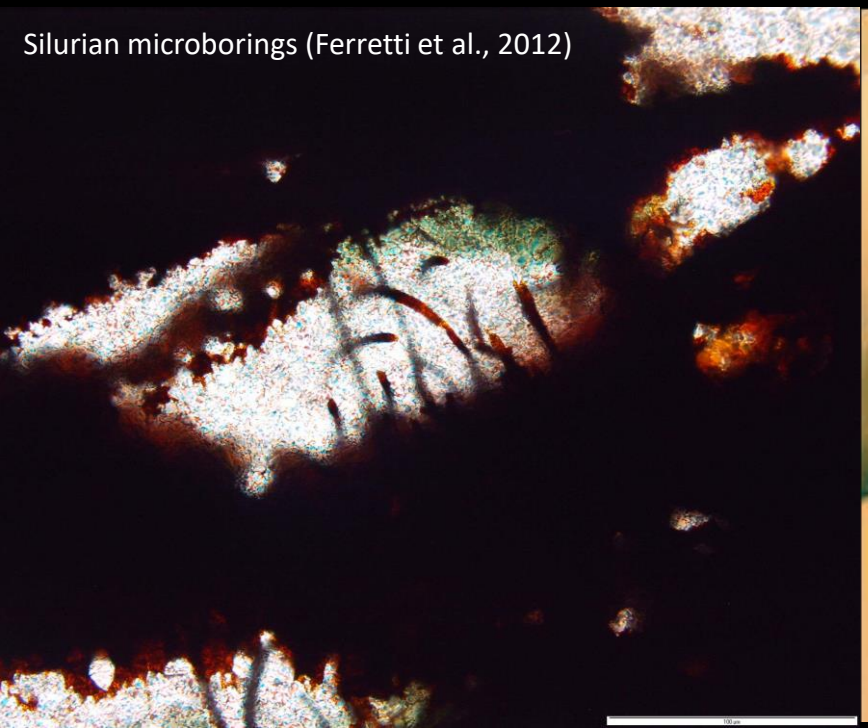
Leonardo da Vinci used trace fossils as biosignatures

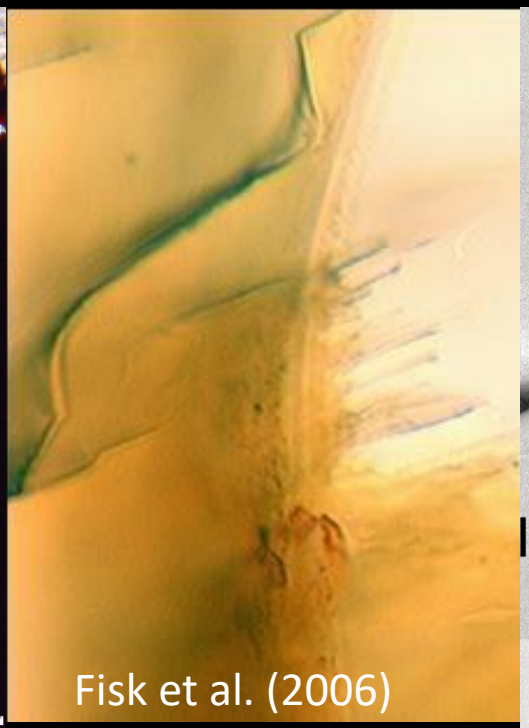
Baucon (2010)

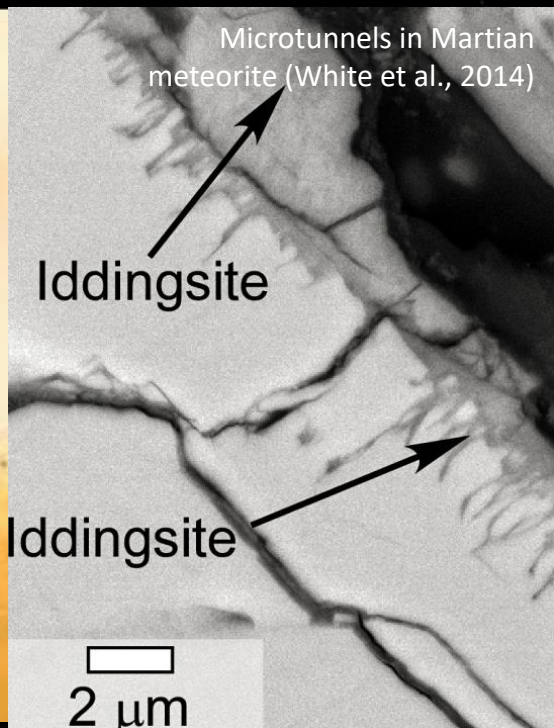
*«[The Inorganic Theory is not true] because **the trace of the animal's movements** remains there on the shell which is consumed by the animal as a woodworm on the wood[…]»*

- Leonardo da Vinci, Leicester Codex, folio 9v

Eventual microborings may survive meteorite impact


Silurian microborings (Ferretti et al., 2012)


Fisk et al. (2006)



«Among one and another rock layer, there are the traces of the worms that crawled in them when they were not dry»

«Come nelle falde, infra l'una e l'altra si trovano ancora gli andamenti delli lombrici, che caminavano infra esse quando non erano ancora asciutte»

- Leonardo da Vinci, Leicester Codex, folio 10 v

Traces preserve the activity of soft-bodied organisms

Very Poorly Sorted

Prismoidal

Traces are resilient to tectonism and metamorphism

Trilobite burrows in the Ordovician quartzites of Penha Garcia (Portugal)

A big problem? The same trace occurs at different ages

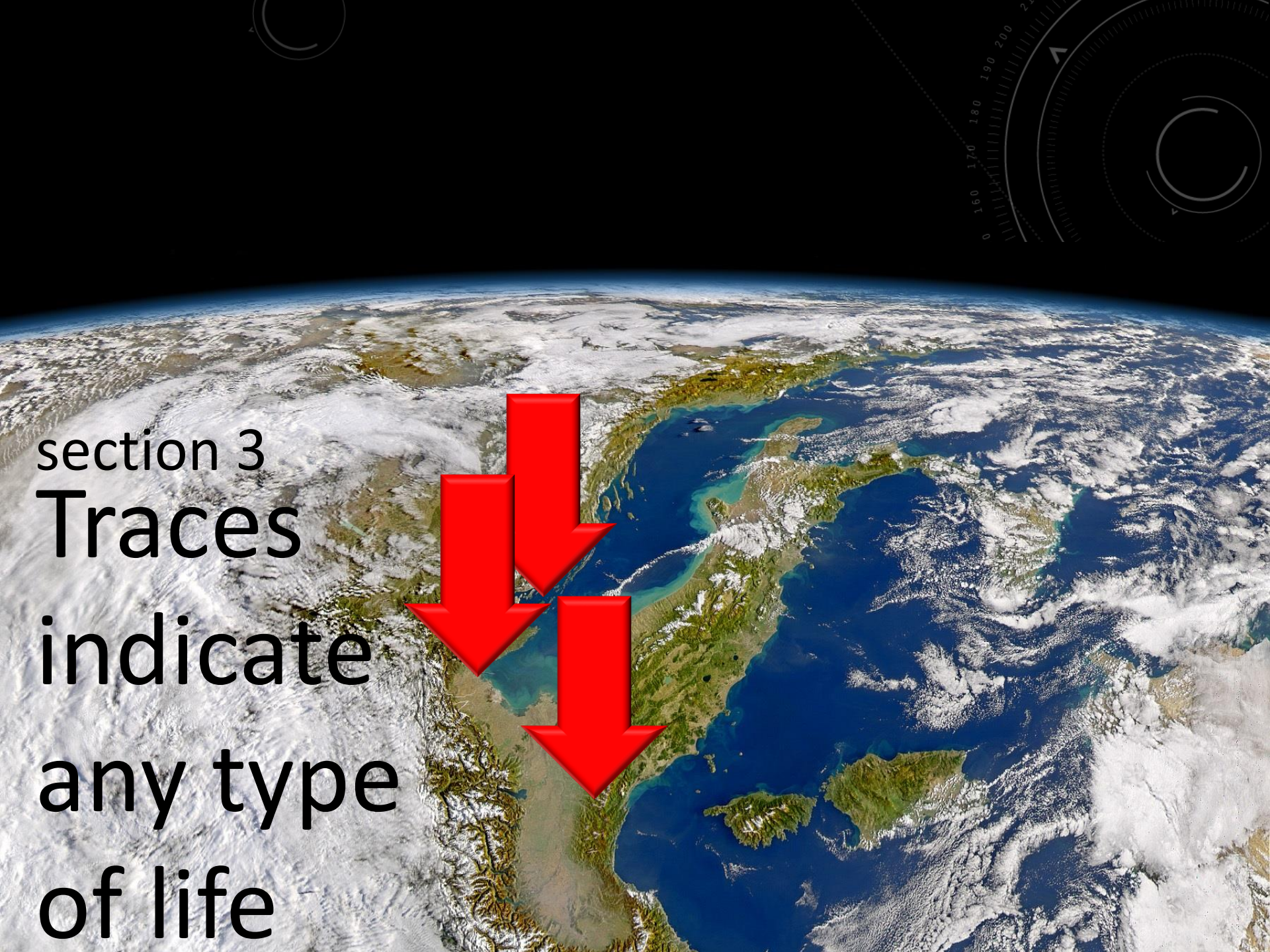
Ordovician (470 mya), Portugal

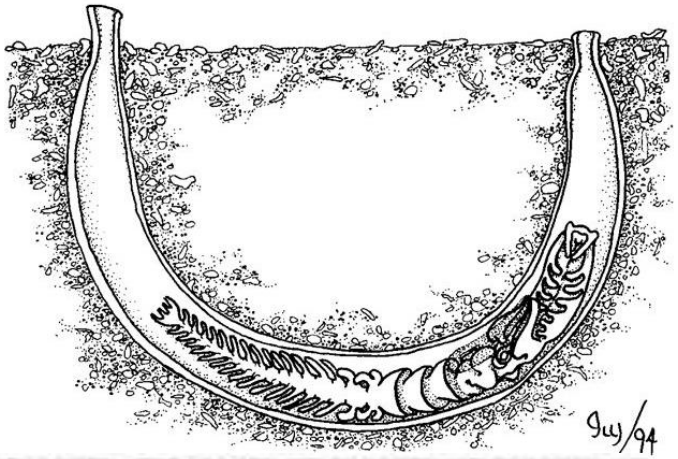
Pliocene (2.5 mya), Italy

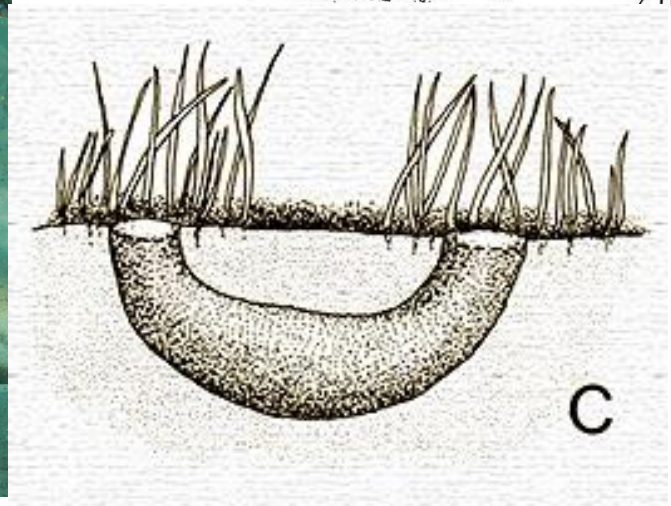
modern, Italy

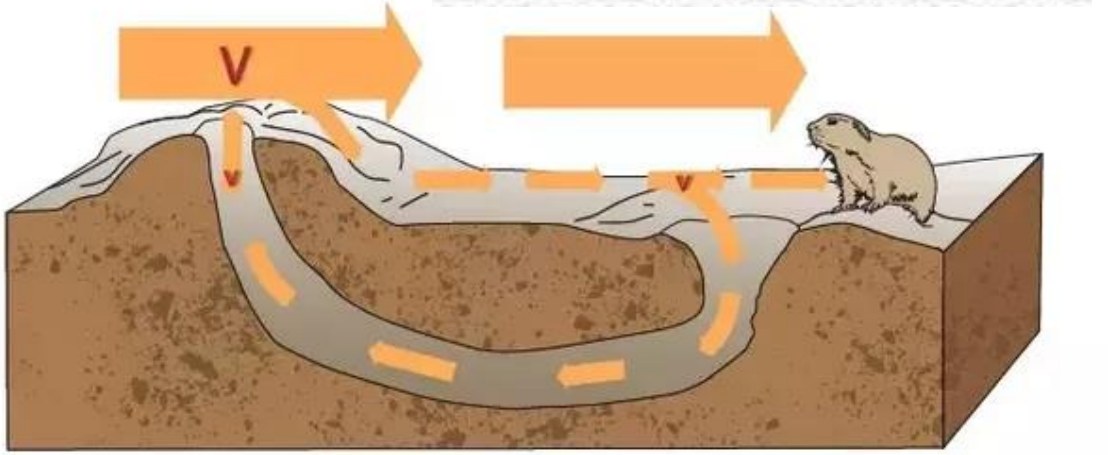
section 3

Traces indicate any type of life



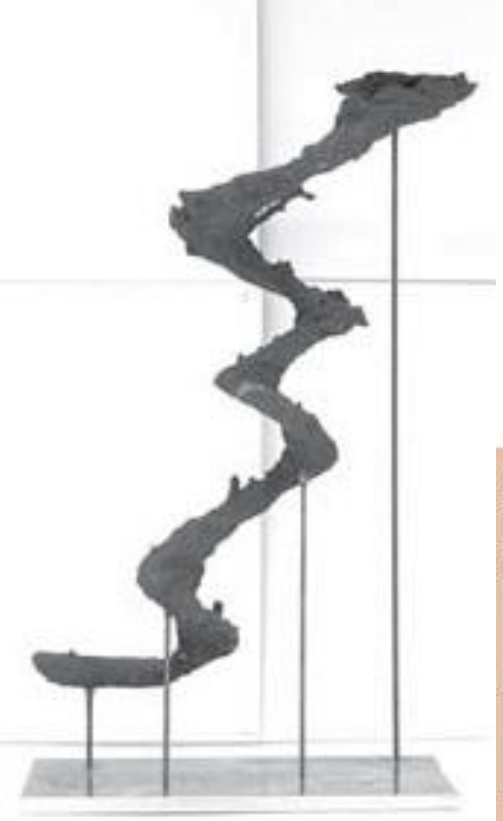


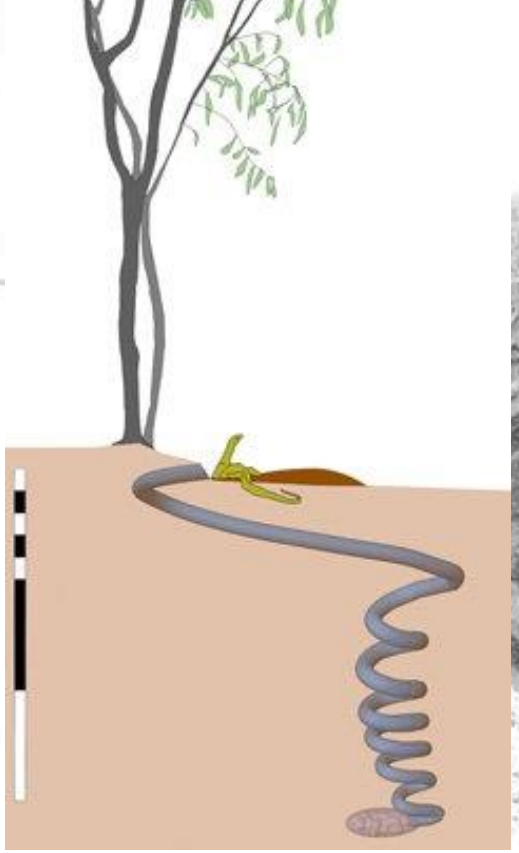


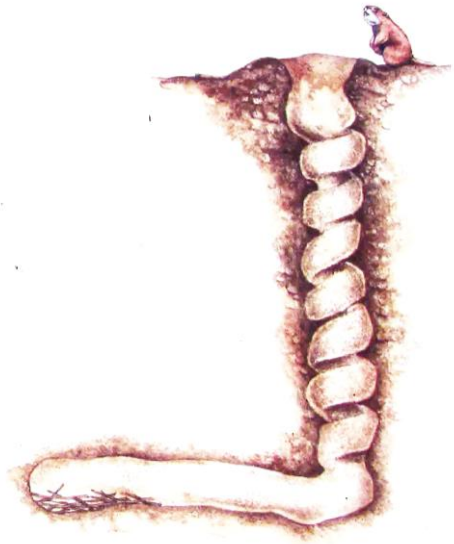


Different organisms can produce the same trace

Traces are independent from size and biochemistry of the producer

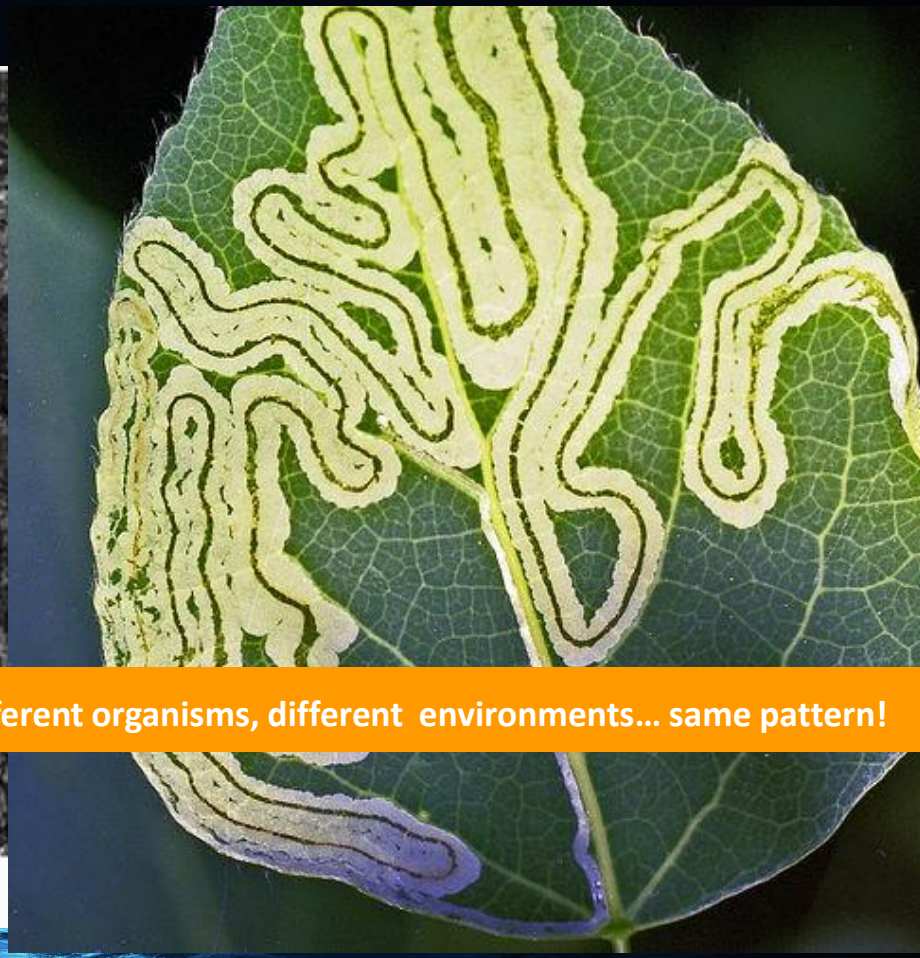






Meanders

Images from Haentzschel (1975), Seilacher (2007)



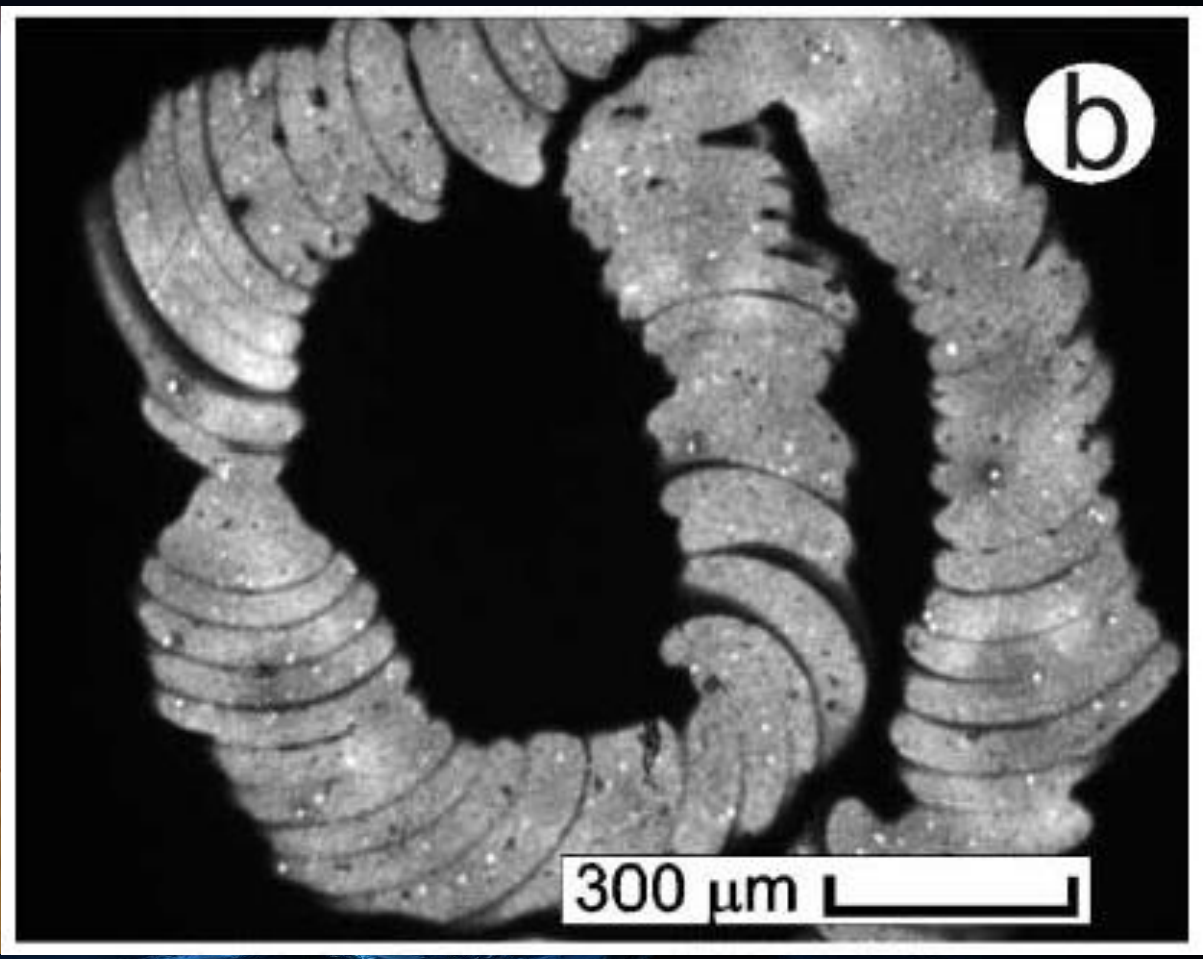
Different times, different organisms, different environments… same pattern!

Deep-sea grazing trace fossil
Produced by annellids?
Cretaceous

Terrestrial grazing trace
Produced by insects
Modern

2.2 Meanders

Garcia-Guinea et al. (2006)



Boring

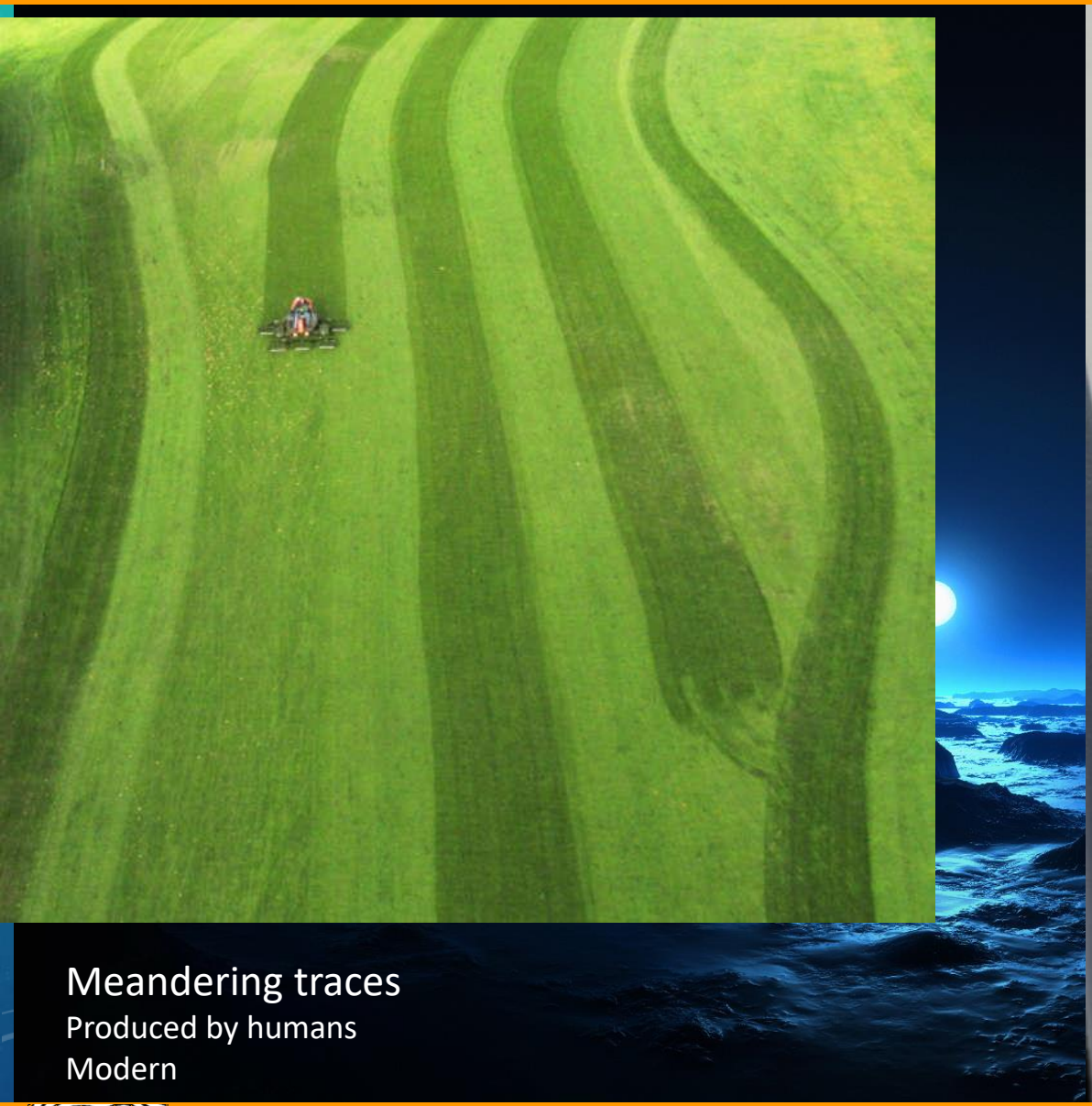
Produced by fungi

Modern

Different scale… similar pattern!

Self-avoiding: a time- and scale-independent strategy

Baucon (2010)



Meandering traces

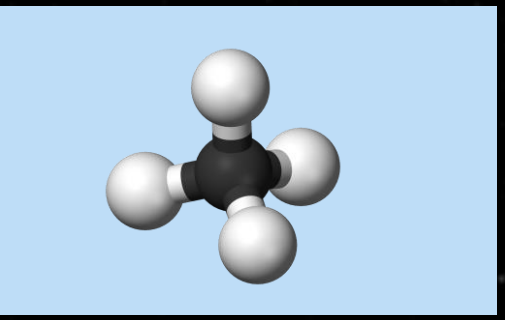
Produced by humans

Modern

Plato’s cave revisited: traces allow to detect life that differs from known life

Conclusions

morphology



biochemistry

behaviour

?

Further studies: the Adriatic Sea as an open-air astrobiological lab

THANK YOU!