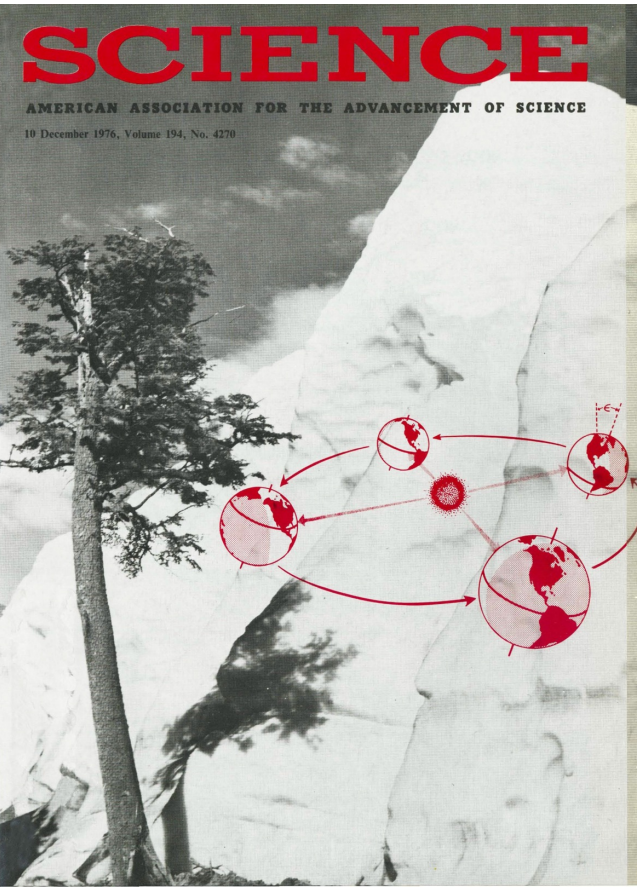
"100 ka" cycle and eccentricity myths.

PAGES AGADIR 2022

6th Open Science Meeting

Learning from the past for a sustainable future

Martin Kölling
MARUM - Center for Marine Environmental Sciences
Bremen, Germany *koelling@uni-bremen.de*
53.0851 N, 8.8284 E

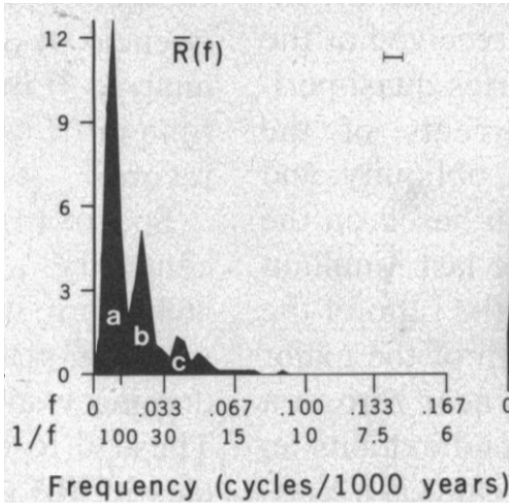


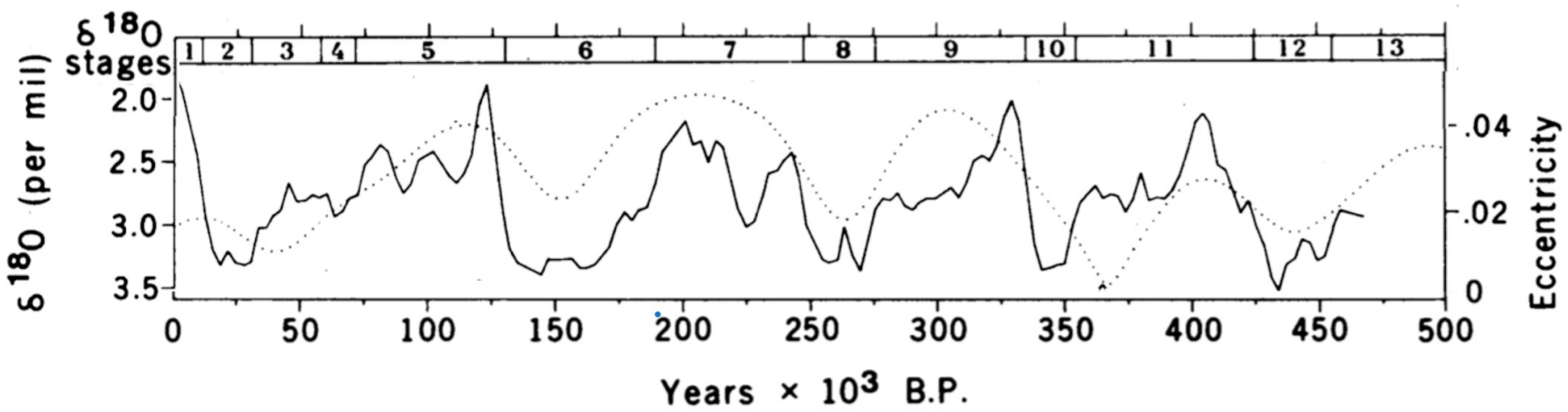
10 December 1976, Volume 194, Number 4270

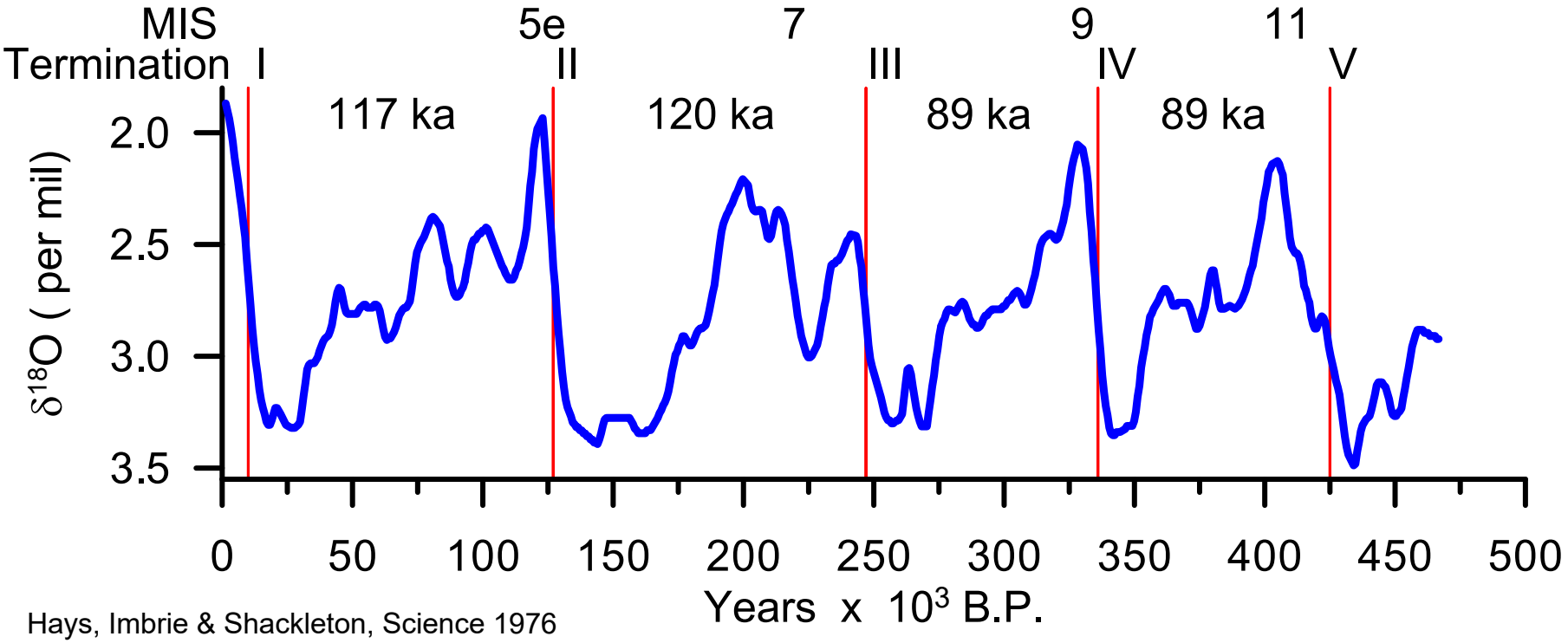
Variations in the Earth's Orbit: Pacemaker of the Ice Ages

For 500,000 years, major climatic changes have followed variations in obliquity and precession.

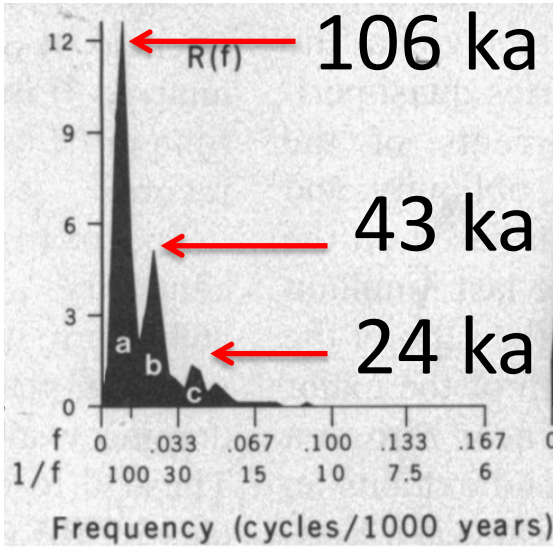
J. D. Hays, John Imbrie, N. J. Shackleton







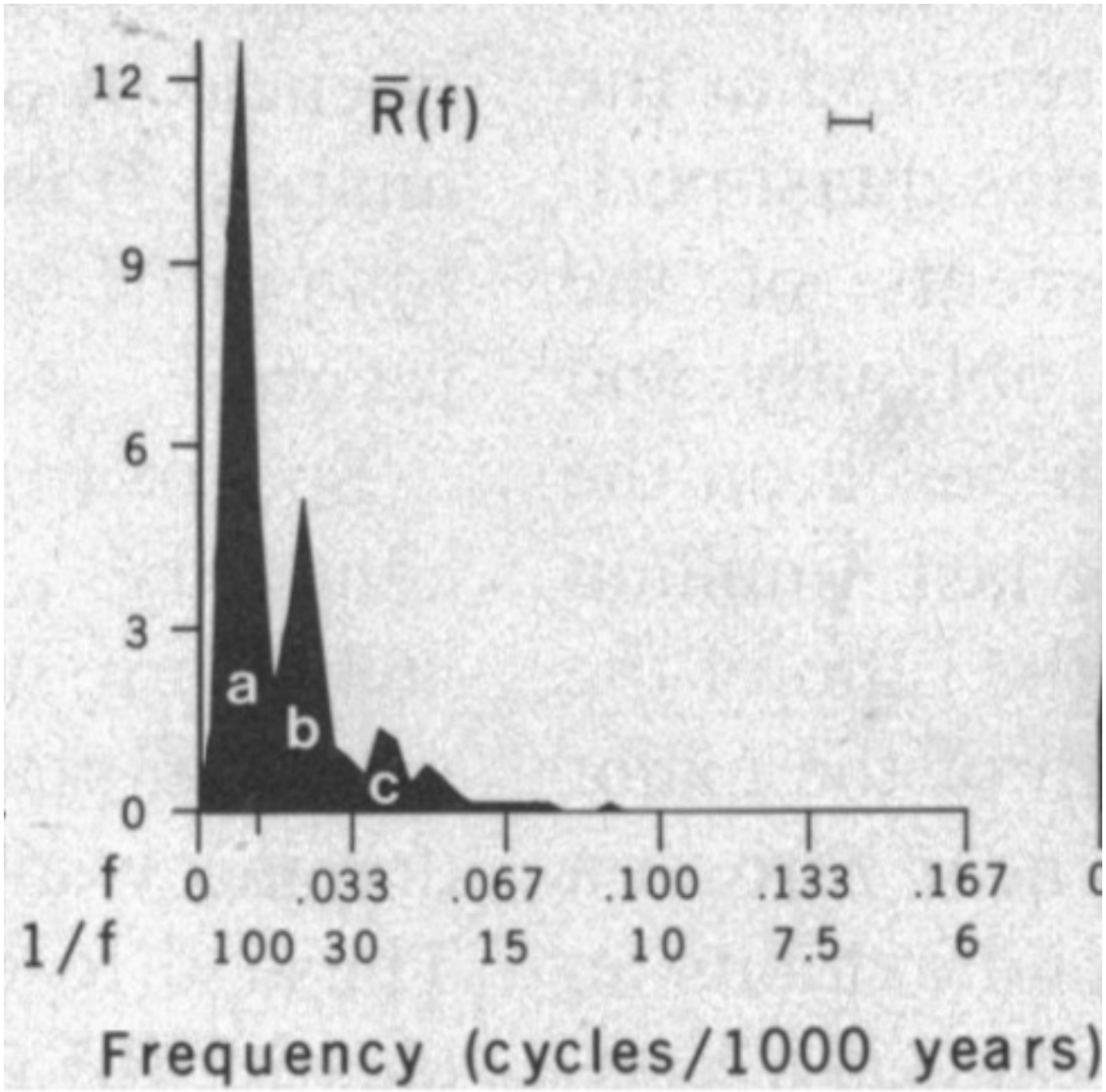
Hays, Imbrie & Shackleton, Science 1976

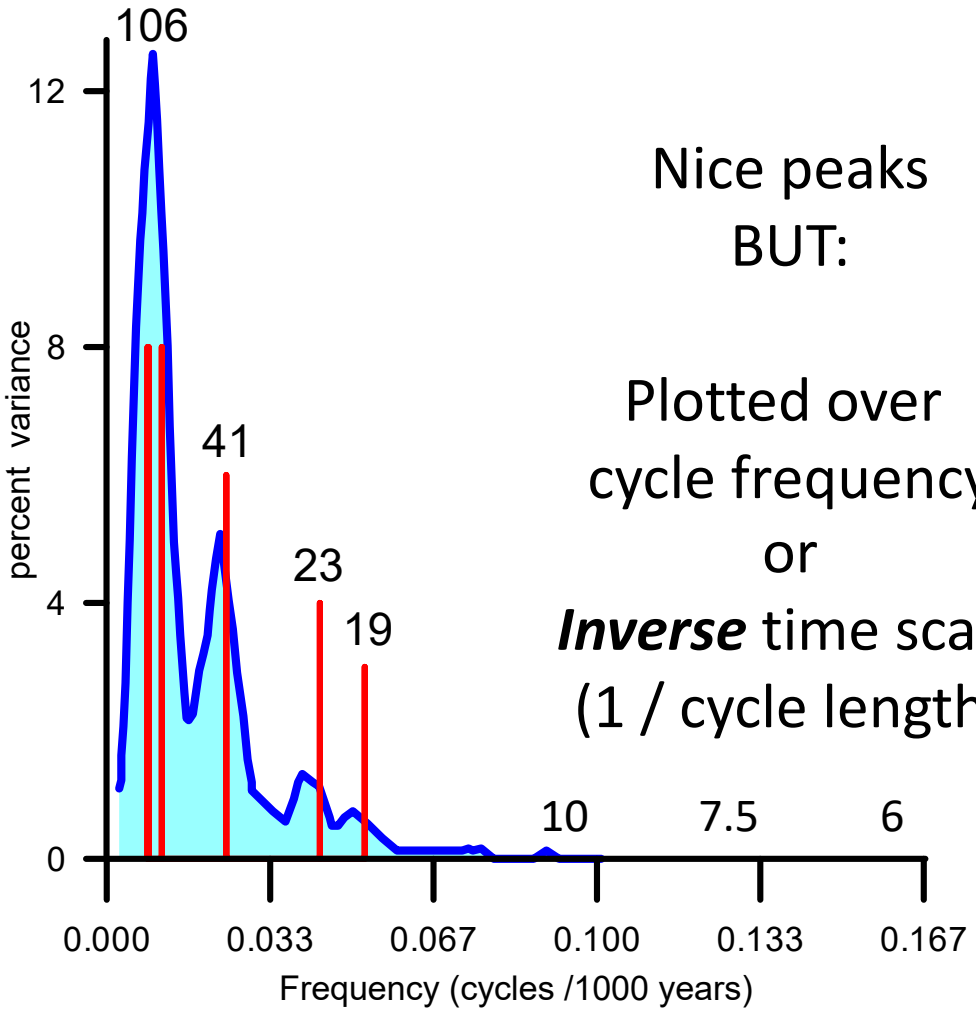


106 ka -> ?? eccentricity (avg. 105 ka)

43 ka -> obliquity (avg. 41 ka)

24 ka -> precession (avg. 23 & 19 ka)

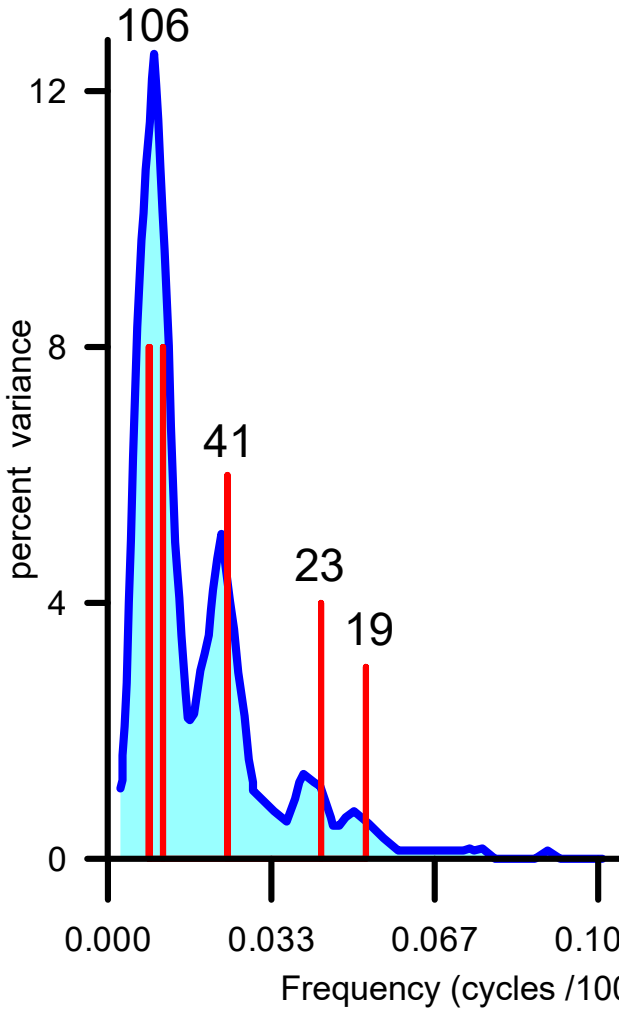

12
9
6
3
0
$\bar{R}(f)$
a
b
c
f 0 .033 .067 .100 .133 .167
1/f 100 30 15 10 7.5 6
Frequency (cycles/1000 years)

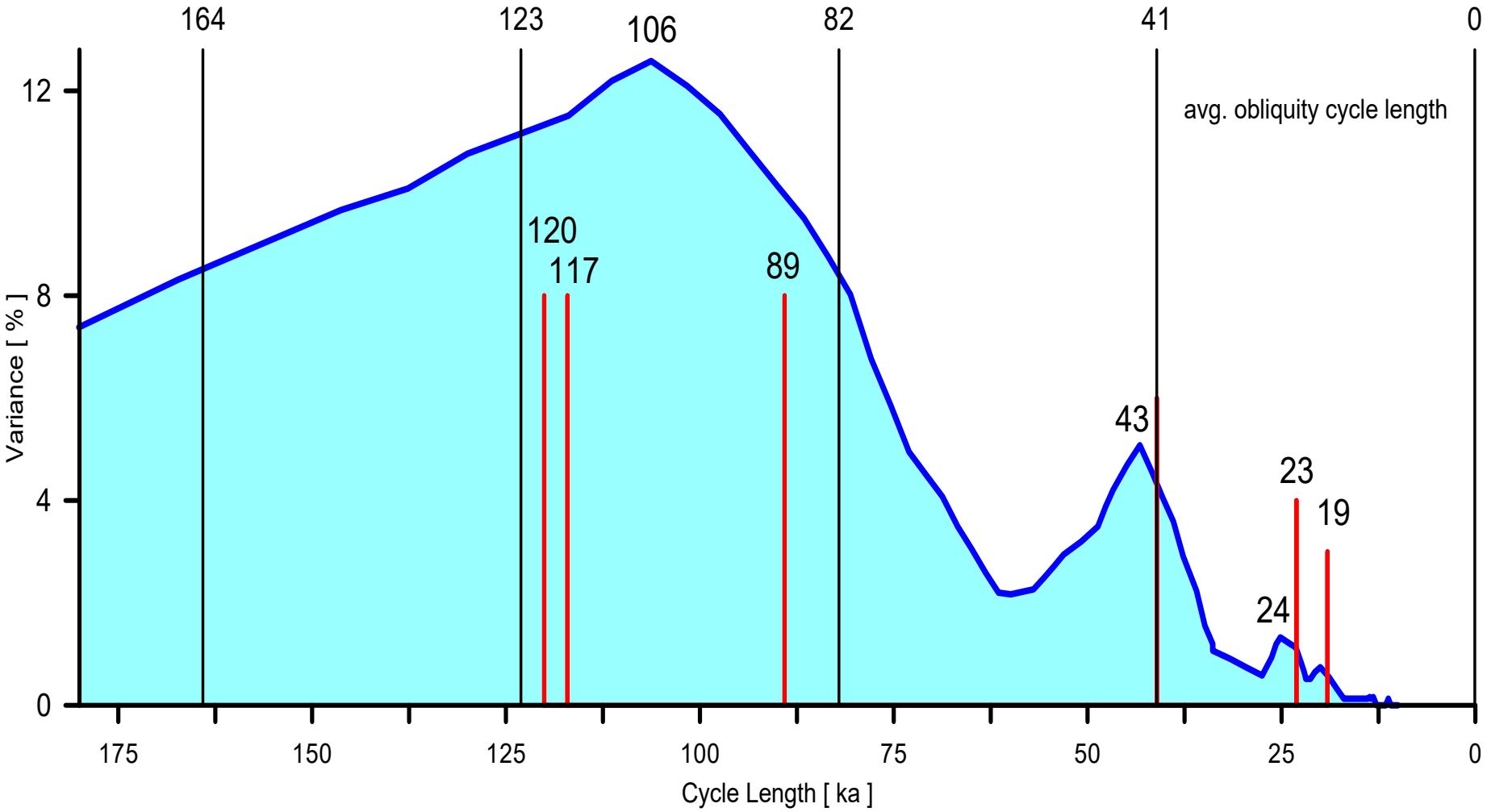


Nice peaks
BUT:

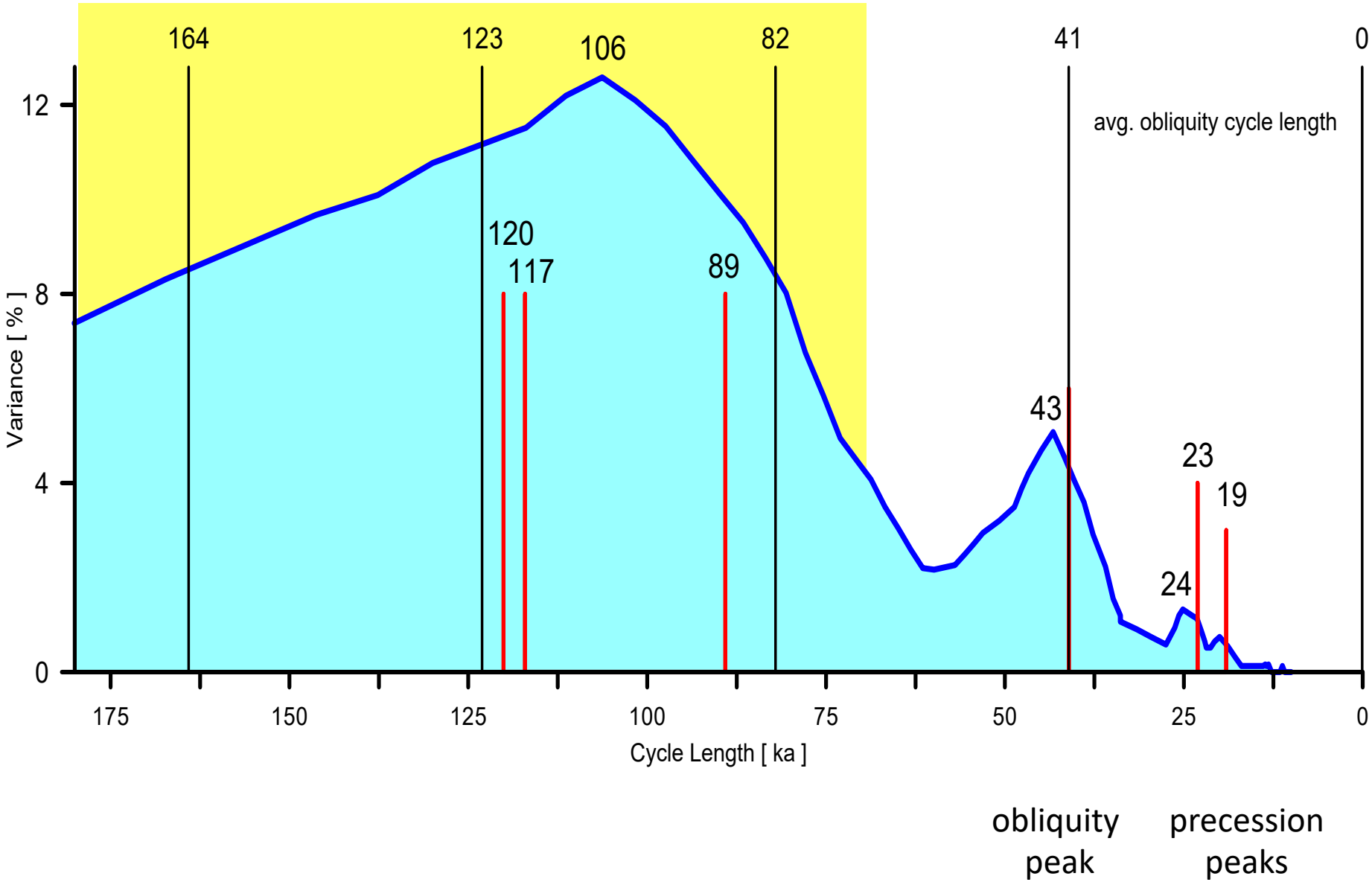
Plotted over
cycle frequency
or
Inverse time scale
(1 / cycle length)

Invert back to a linear time scale:

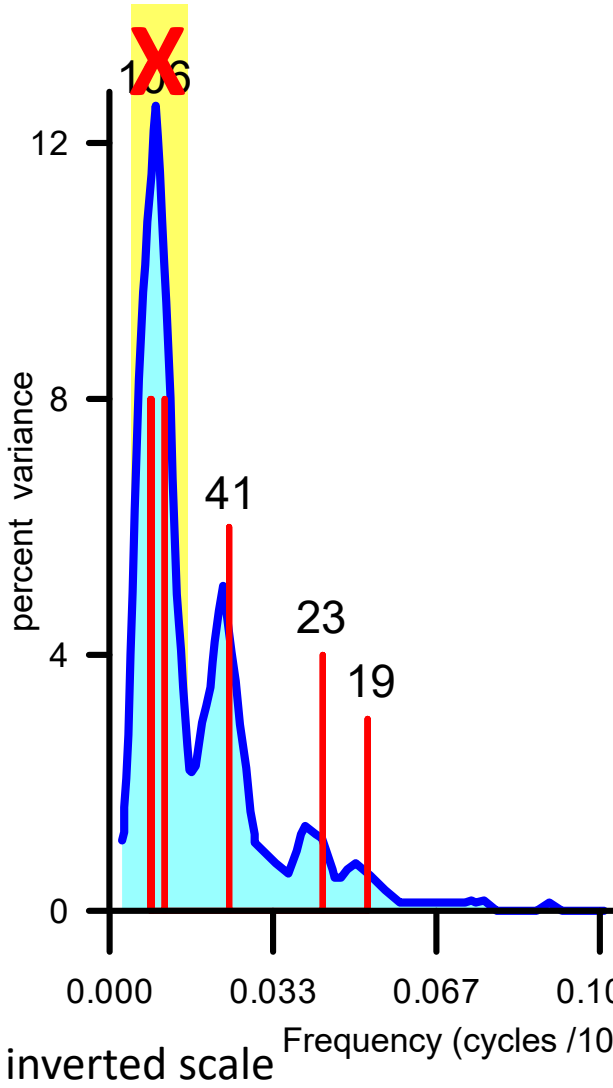




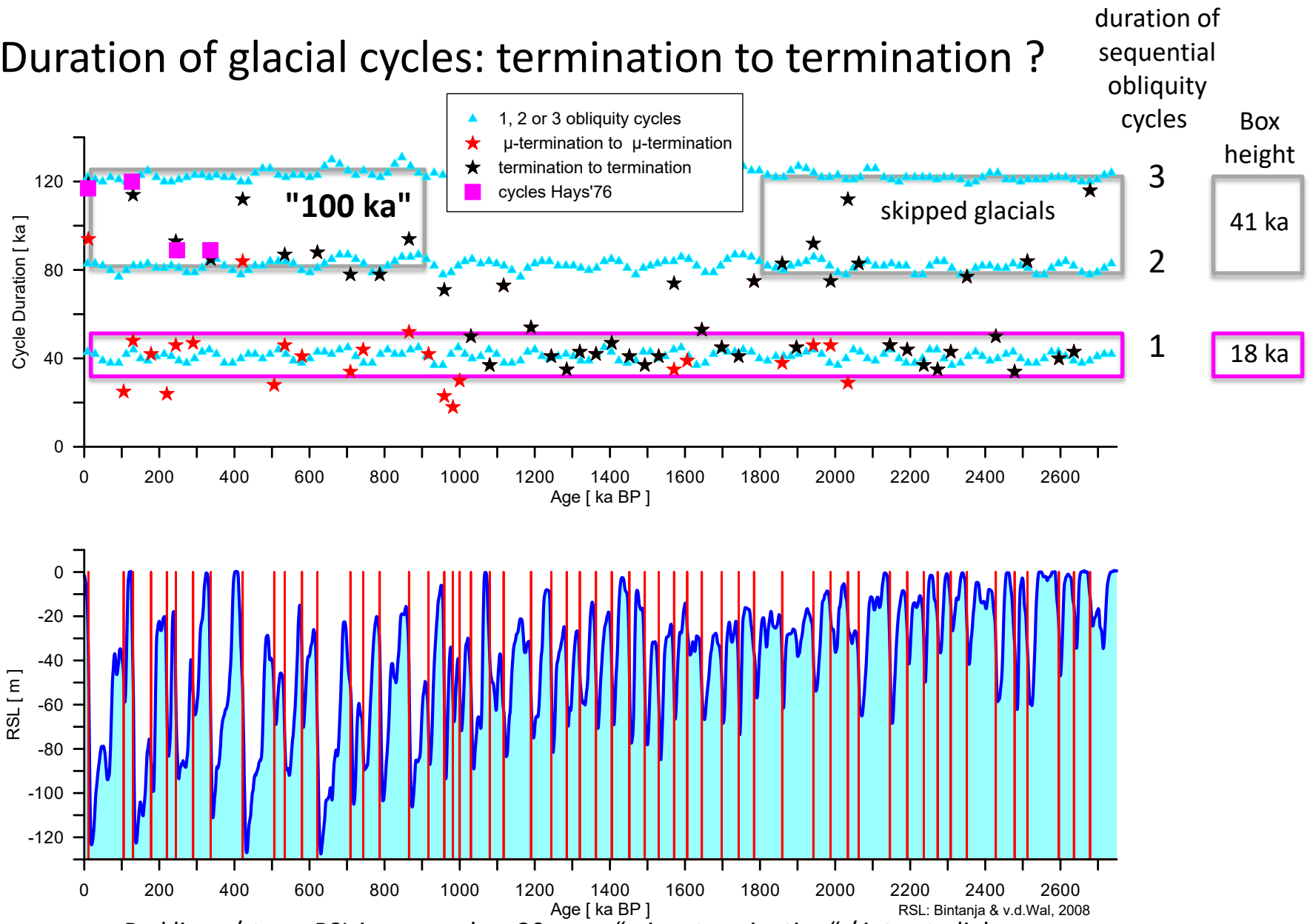
Same plot on BUT ***linear*** time scale


164
123
106
82
41
0
avg. obliquity cycle length
120
117
89
43
23
19
24
12
8
4
0
Variance [%]
175
150
125
100
75
50
25
0
Cycle Length [ka]
obliquity peak
precession peaks

"2 to 3 obliquity cycles peak" or
"everything longer than 70 ka peak"

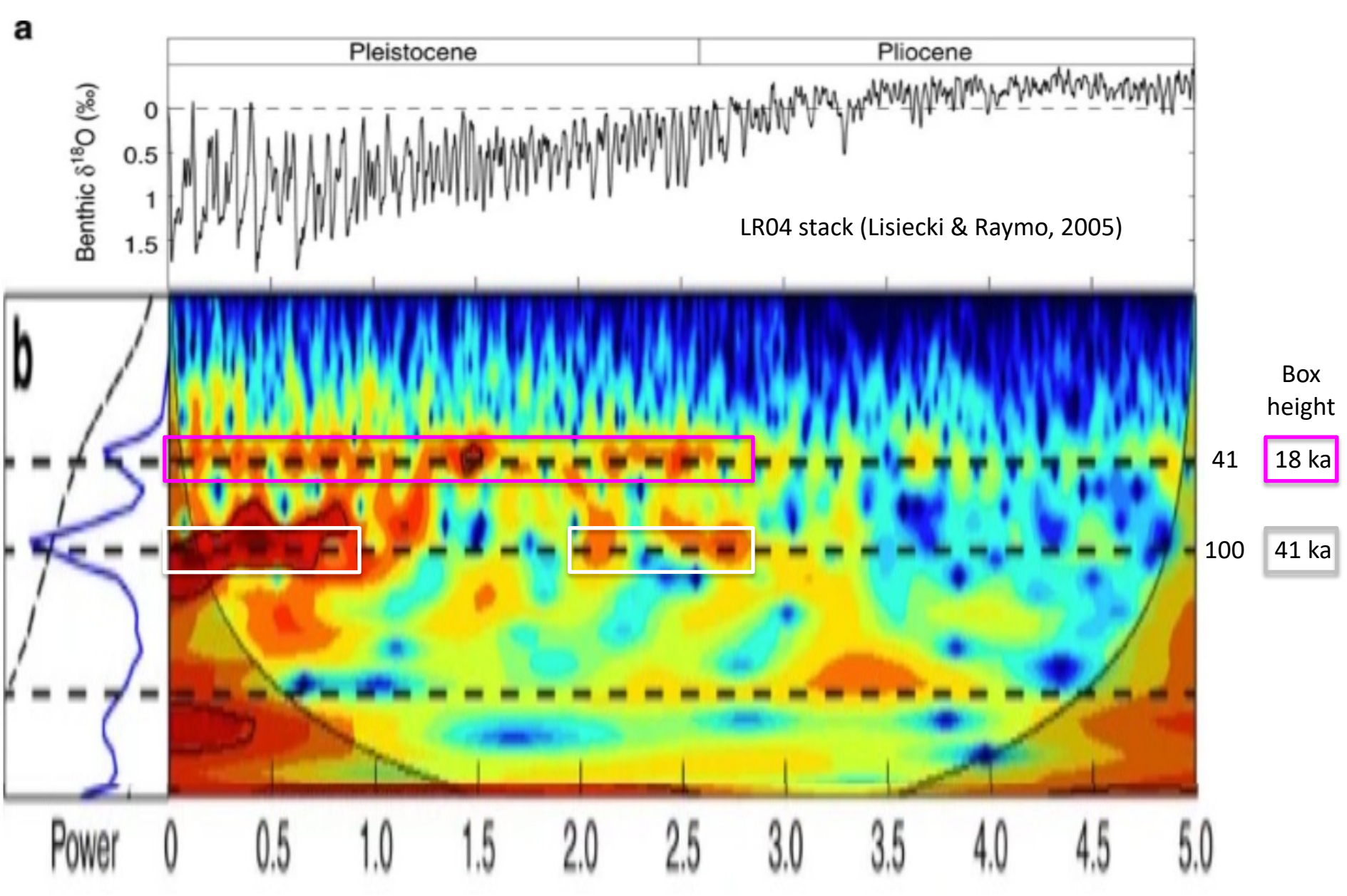


Duration of glacial cycles: termination to termination ?

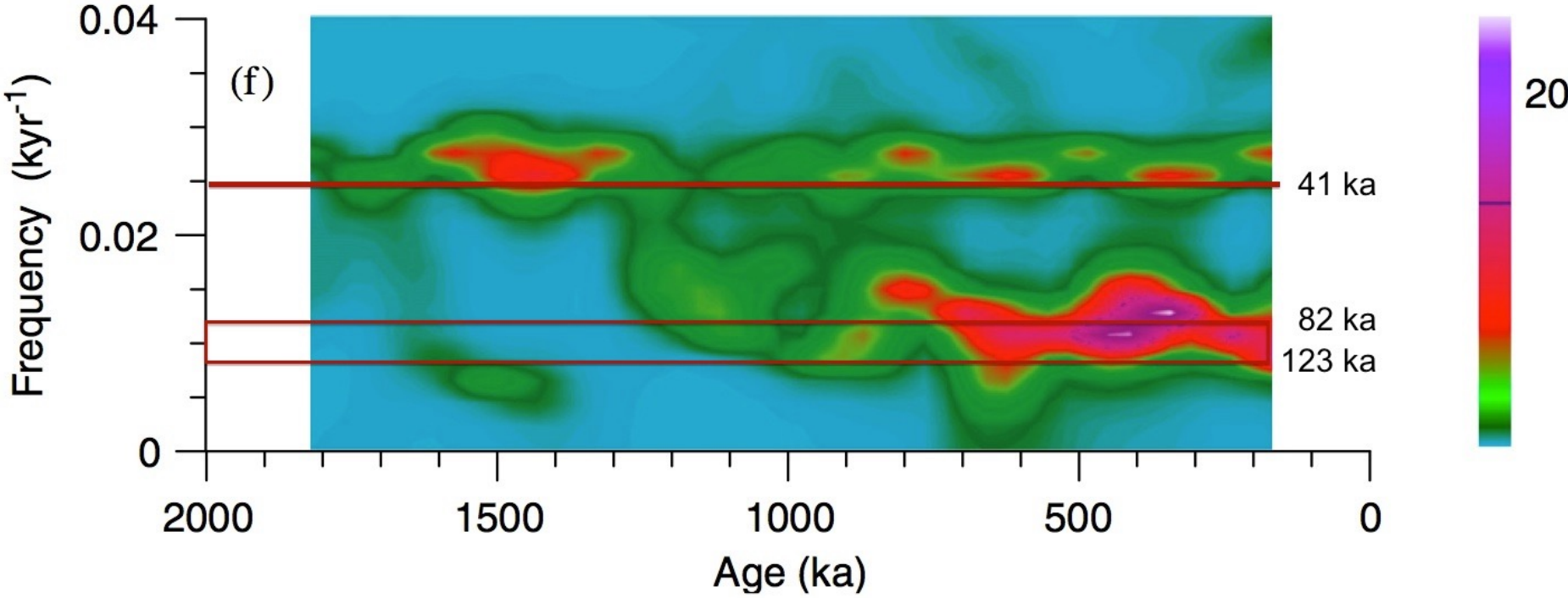


Red lines /stars : RSL increases by >20m -> “micro termination“ / interstadial

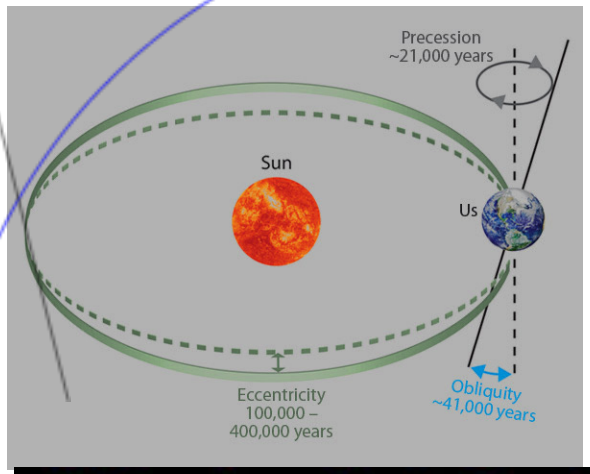
Black stars: classical terminations. All stars at the end of glacial phase

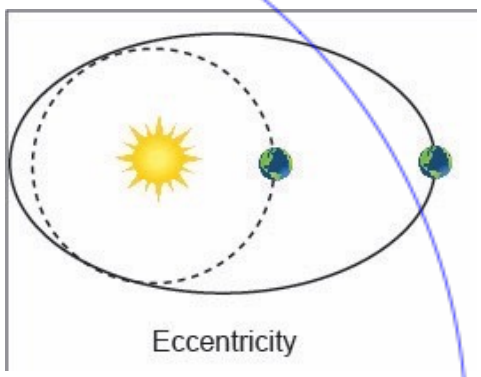


Wavelet spectrogram of LR04 from de Boer at al 2014

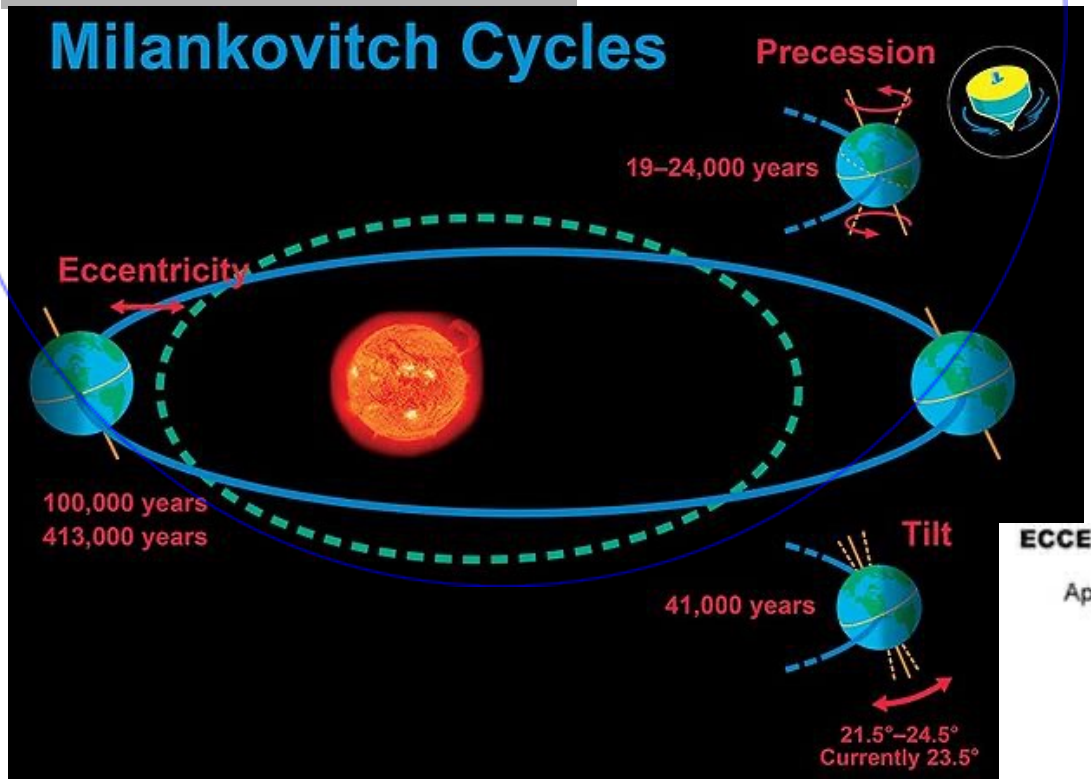


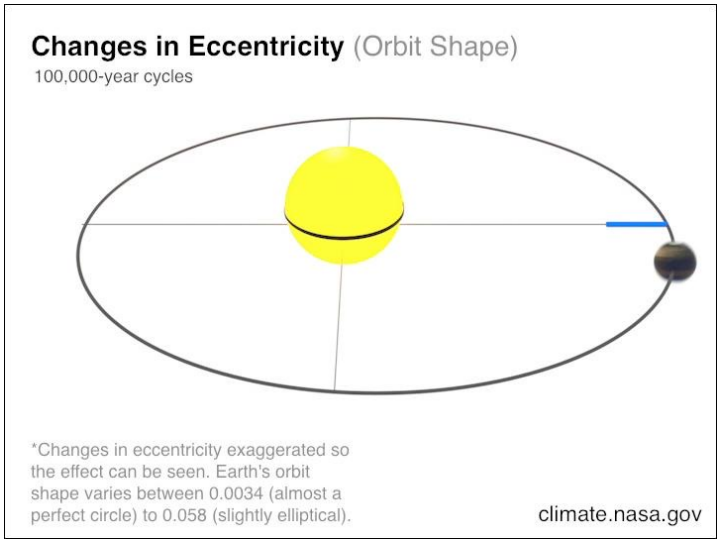
Clark et al. QSR, 2006, fig14f (LR04 stack)

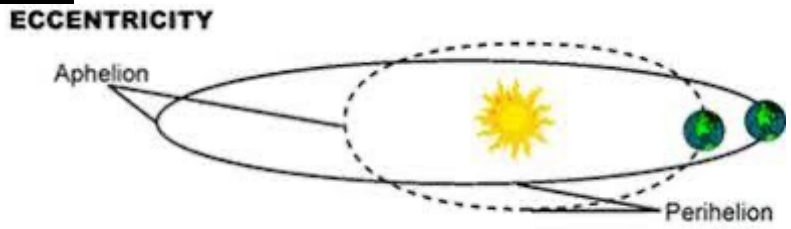


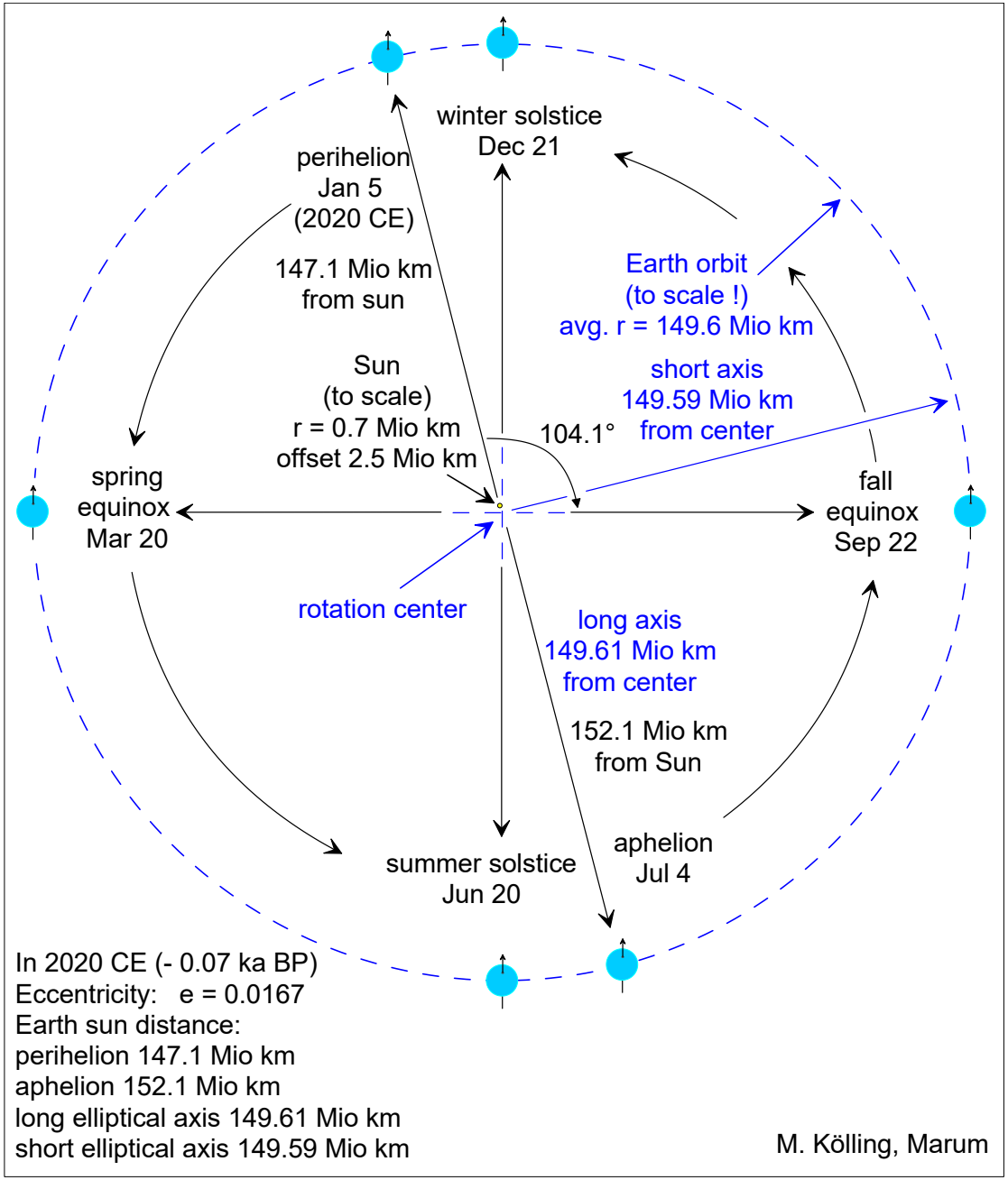


Graphic representations of the eccentricity of Earth's orbit are usually tremendously exaggerated and often plainly wrong.









The full range of the eccentricities of Earth's orbit at this scale ***all*** look perfectly circular

Eccentricity is not "ellipticity" ! It refers to the sun not being perfectly in the center of an elliptical orbit but in one of the two foci. The elliptical shape itself hardly has any influence on irradiation.

Currently, the sun is offset by 2.5Mio km from the center. There is a 5 Mio km or 3.4% difference between perihelion (147.1 Mio km) and aphelion (152.1 Mio km) while the difference between the long and short elliptical axis is only 0.02 Mio km or 0.013% !