MATTERS ARISING

SOLAR SIGNATURE IN SEDIMENTARY CYCLES

Williams and Sonett[1] analysed climatic cyclicity recorded by regular variations in the thickness of varves in the late Precambrian Elatina Formation, a periglacial lake deposit in South Australia, and concluded that the cycles, which range from about 11 to 9300 years in duration, reflect solar variability. They also suggested that solar influence on climate must have been much greater during the deposition of the 680 Myr old varved formation than is evident now. This prompts a comparative review of other prominent data on climatic cycles.

Lamb[2] compiled into one table a particularly comprehensive compendium of cyclicities from measurements of a wide variety of parameters embracing direct observation of sunspots, radio-active carbon in the Earth's atmosphere, direct temperature measurement, rainfall, wind directions, sea-ice cover, severity of winters, annual ice cap thickness, night cloudiness, geographical pressure differences, anticyclone location, meridional circulation pattern frequency and varve thicknesses from strata as young as Pleistocene, through Miocene, Oligocene, Eocene, Cretaceous, Jurassic, Permian, Carboniferous and Devonian, to pre-Cambrian. To these might be added, for examples among many others, data on tree ring cycles, glacial phenomena and so on provided by Sonett and Suess[3] and Hayes et al[4] to assist the preparation of the figure. Here all the 88 data items from References 1-4 have been incorporated with mean values taken where ranges have been quoted; inconvenient data has not been omitted.

The figure plots the number of citations of a particular periodicity (the inverse of frequency) against the logarithm of periodicity to enable the presentation of widely different periods on one figure. Particular attention is drawn by arrows to the comparative series of periodicities 22×2^n years, which contains the Hale sunspot cycle of 22 years ($n = 0$) as one of its

components. It is seen that, with the exception of n = 1 and 8 (i.e. 44 and 5632 years), each of the components in the series is present in the cited data along with very few others, especially few in comparison with the number of citations of series components; that the n = 8 component is missing may be due to inadequate data coverage. This visual treatment of the data is consistent with the non-statistical approach praised by Pittock[5] in relation to Reference 1 and may increase confidence in recognising solar cycles in climatic data.

In conclusion this appears to suggest that the same set of frequencies have been in evidence from the pre-Cambrian to the present day, that they correspond to and exceed the series of frequency components so far observed in sunspot cycles and that the corresponding series of periodicities is of the form 22×2^n, where n varies throughout a range at least as great as $-3 \leqslant n \leqslant 12$. Williams and Sonett's recent data form a valuable contribution to the substantiation of this series.

REFERENCES

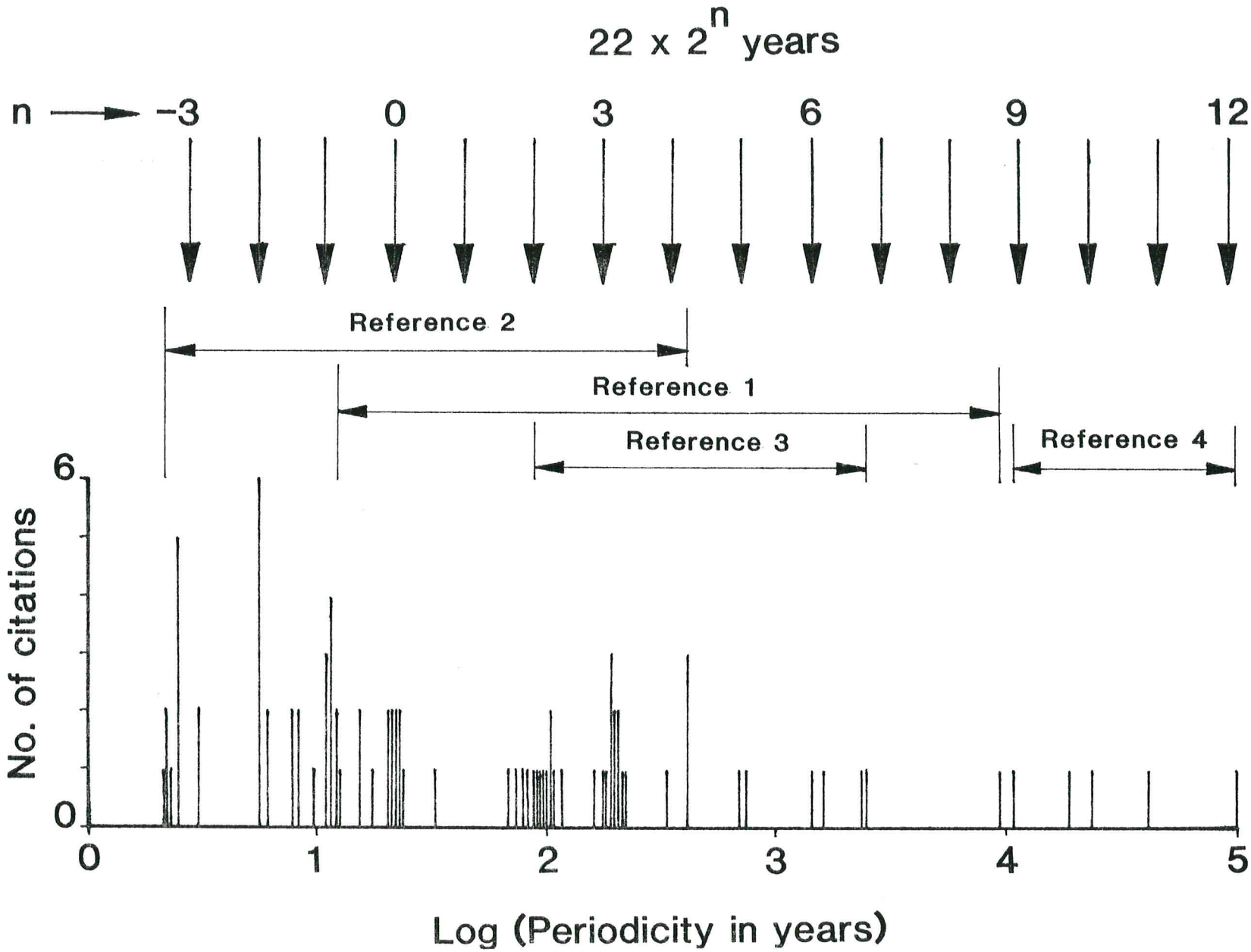
1. Williams, G. E. and C. P. Sonett. Nature 318, 523-527 (1985)

2. Lamb, H. H. Climate Present Past and Future 1: Fundamentals and Climate Now, 242, (Methuen, London, 1972).

3. Sonett, C. P. and H. E. Suess. Nature 307, 141-143 (1984).

4. Hayes, J. D., J. Imbrie and N. J. Shackleton. Science 194, 1121-1132 (1976).

5. Pittock, A. B. Nature 318, 509-510 (1985).


22 x 2^n years
n
-3
0
3
6
9
12
Reference 2
Reference 1
Reference 3
Reference 4
No. of citations
6
0
0
1
2
3
4
5
Log (Periodicity in years)