The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

SMR/1884-14

Conference on Milankovitch cycles over the past 5 million years

22 - 24 March 2007

The Last 50 000 Years

Stephan M. WOODBORNE

Council for Scientific & Industrial Research
Nanoscience Research Group
Building 14, Meiring Naude Road

“THE LAST 50 000 YEARS”
or
^{14}C – MORE THAN JUST DATING

STEPHAN WOODBORNE

TRIESTE MARCH 2007

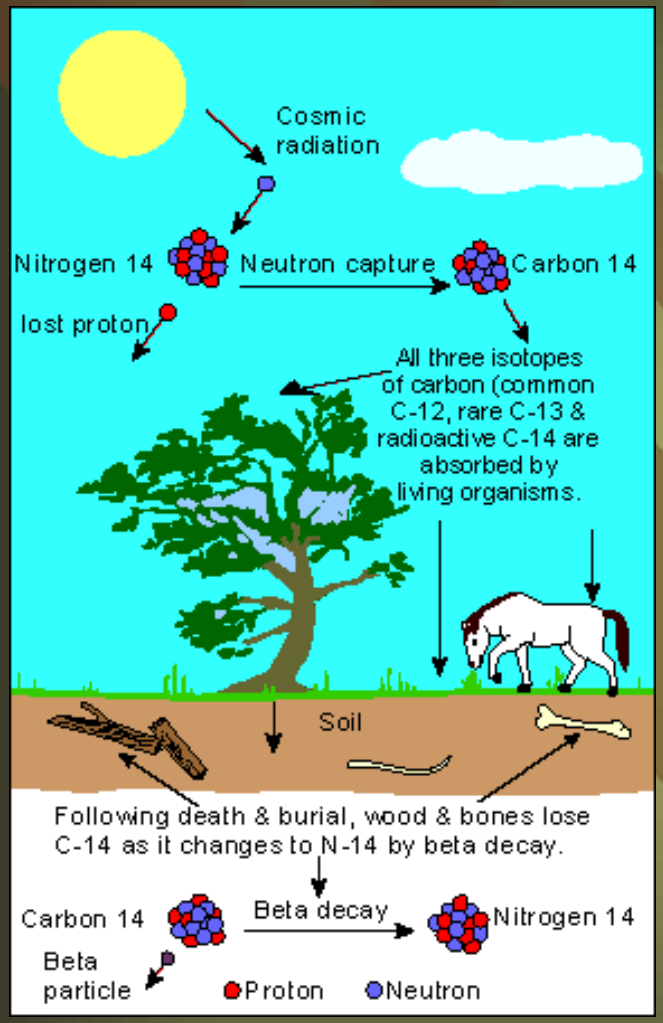
Outline

Some Radiocarbon Basics:
Production effects
Reservoir effects

Constructing a 50 000 year $\Delta^{14}C$ record:
Existing records
The 50-40 000 Cango Cave record

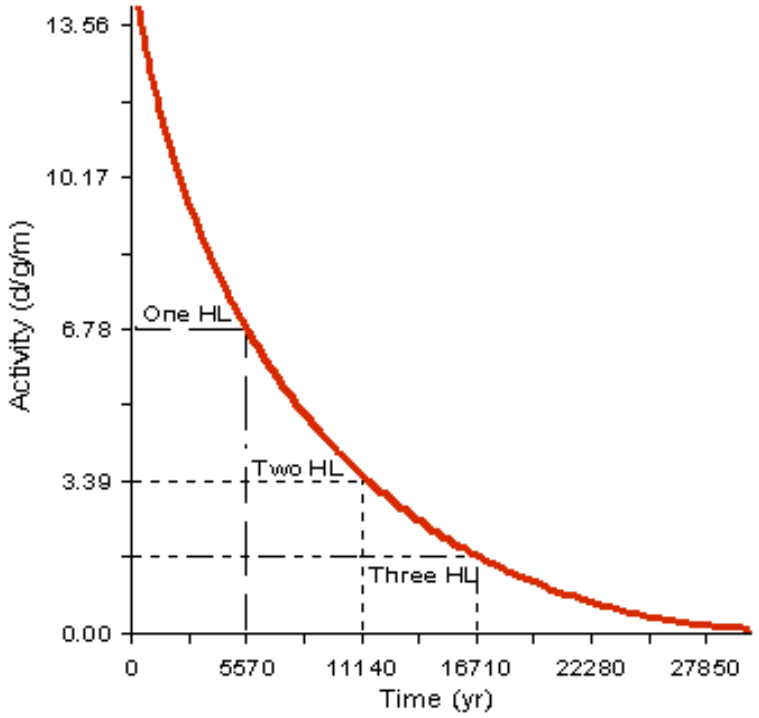
Coupled ocean/atmospheric modeling of $\Delta^{14}C$

Basic Theory of Radiocarbon Dating

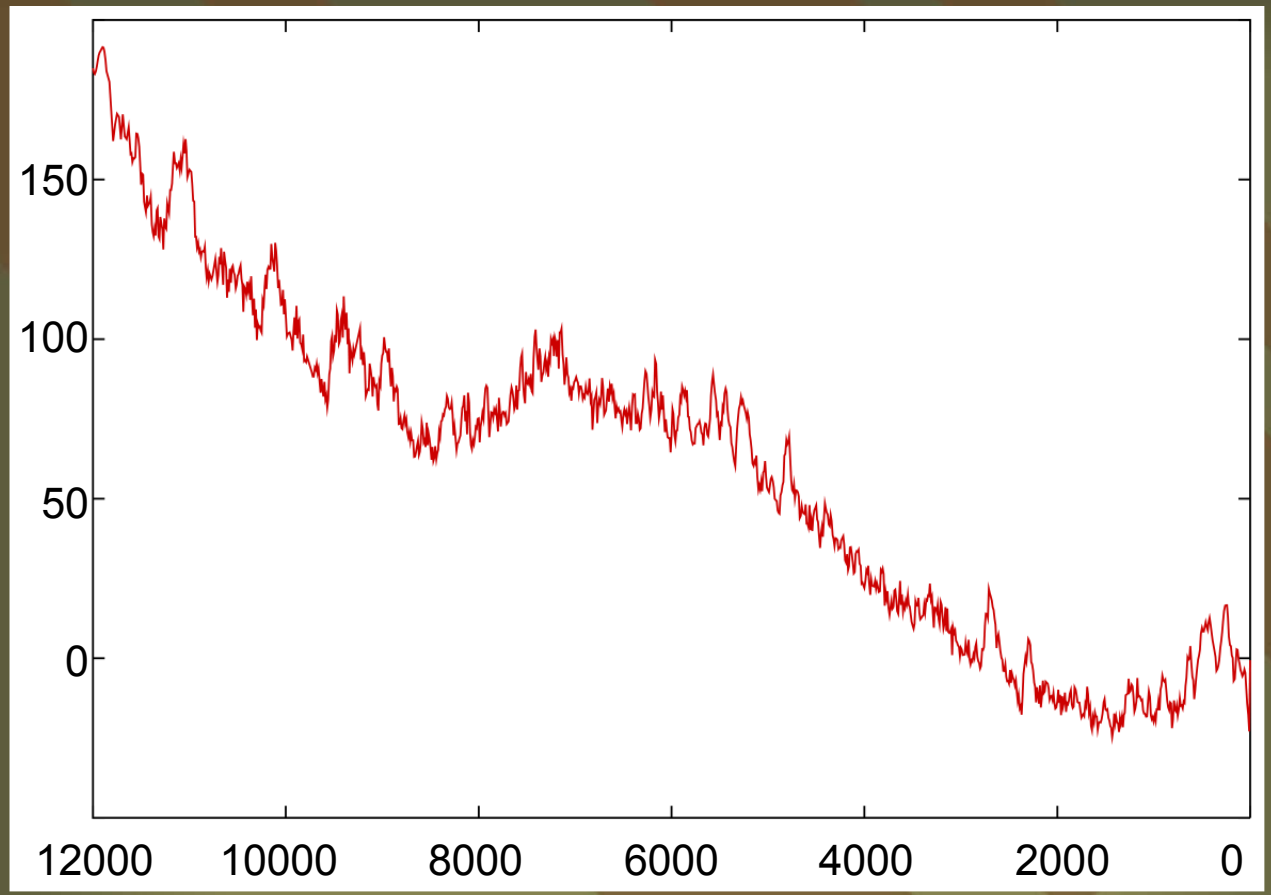


$$ {}^{1}_{0}n + {}^{14}_{7}N \rightarrow {}^{14}_{6}C + {}^{1}_{1}p $$

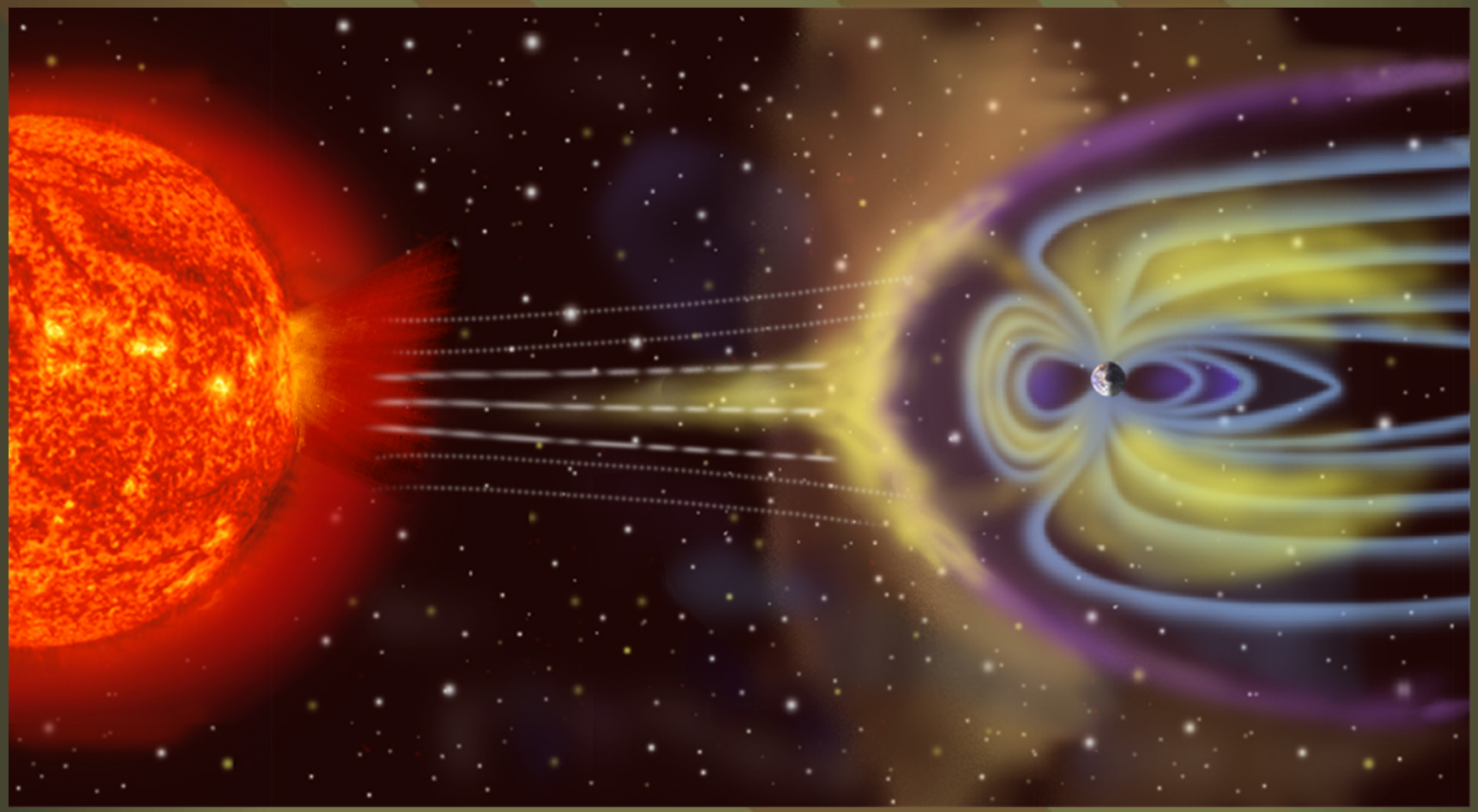
$$ {}^{14}_{6}C \rightarrow {}^{14}_{7}N + \beta^{-} + \gamma(energy) $$



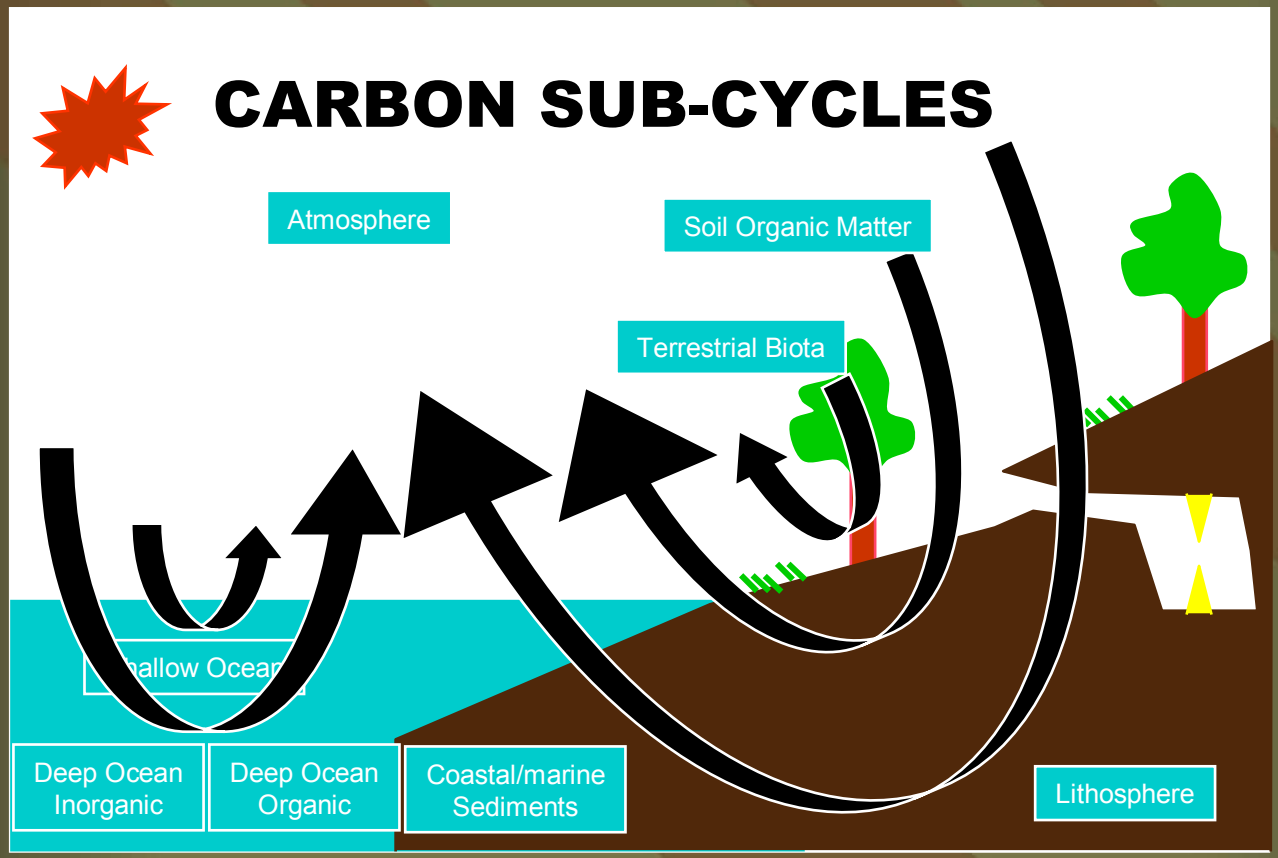
Tree Ring ^{14}C: a record of variability



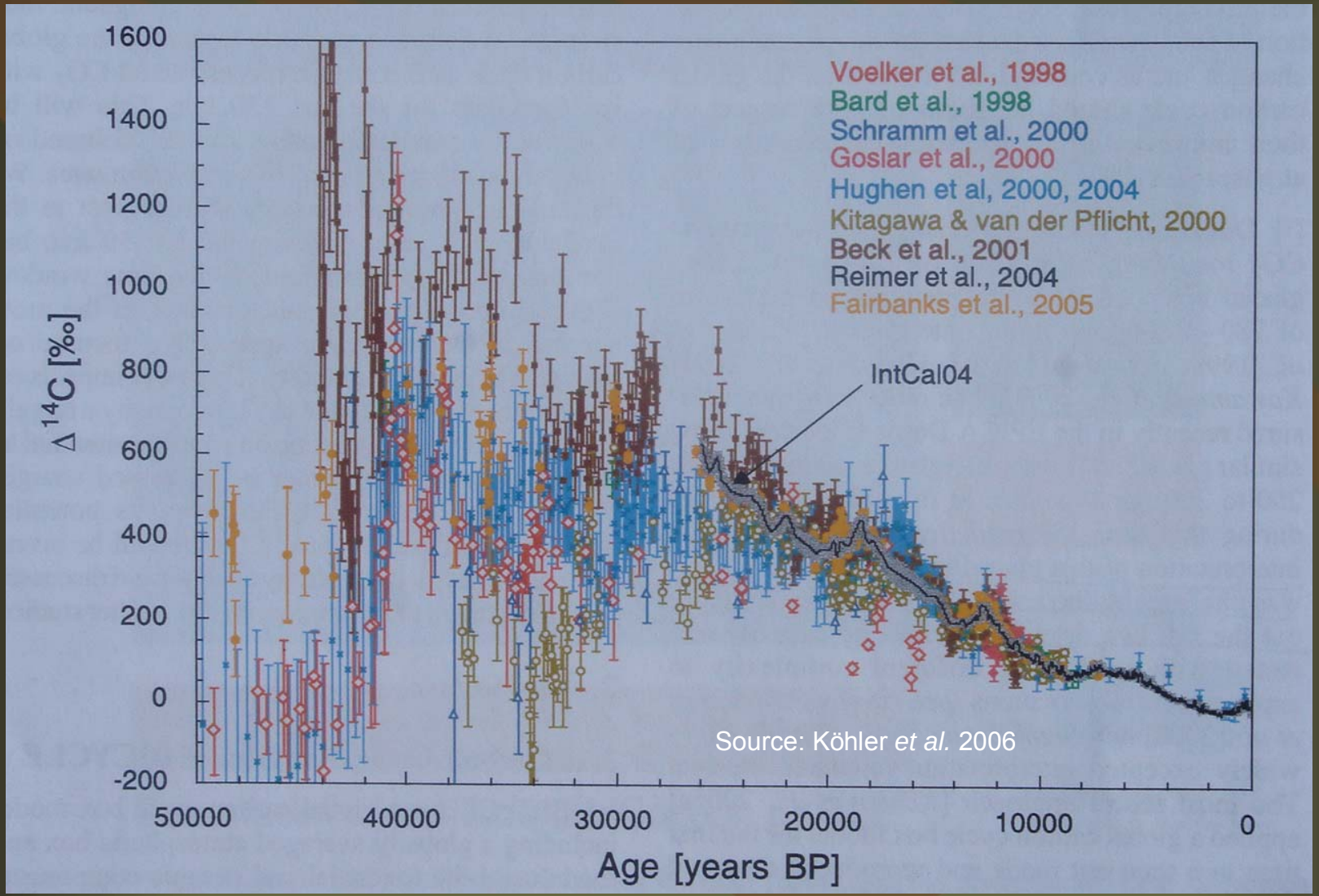
Variations in ^{14}C Production



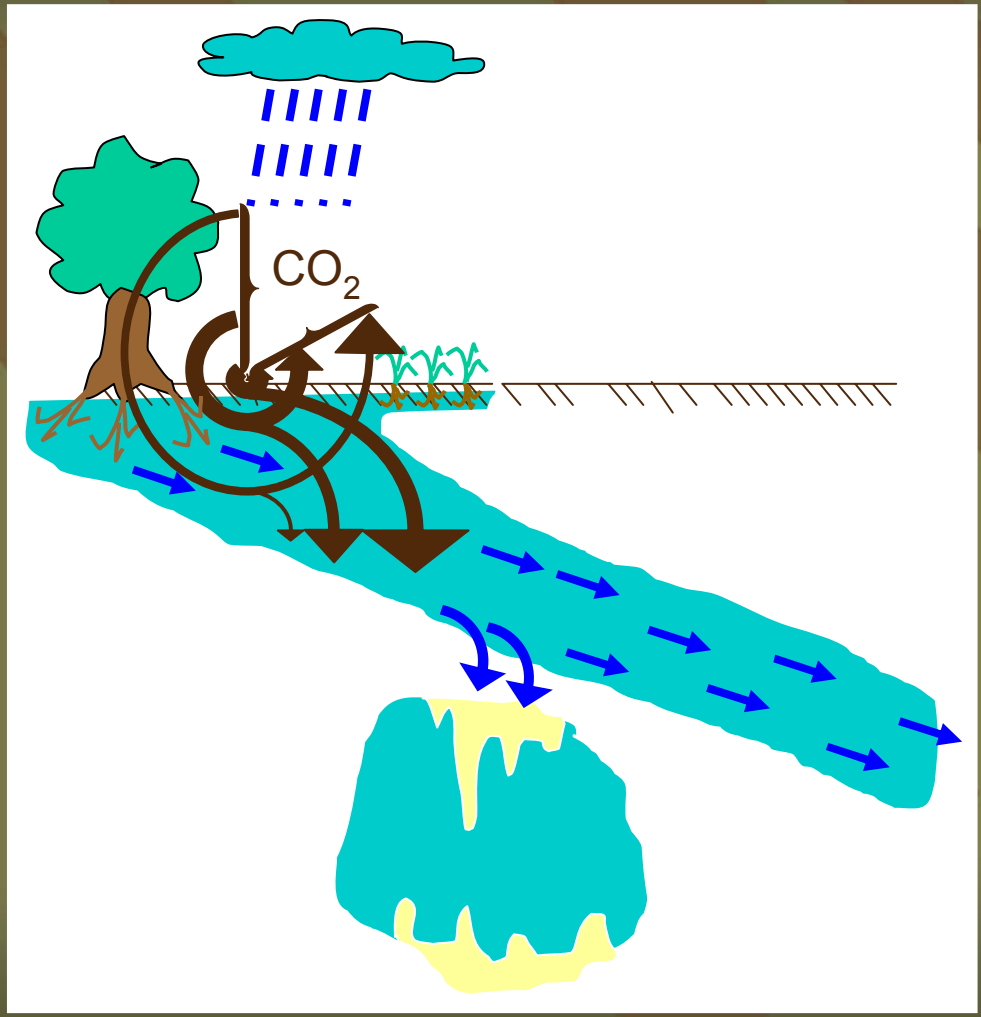
Reservoir Effects



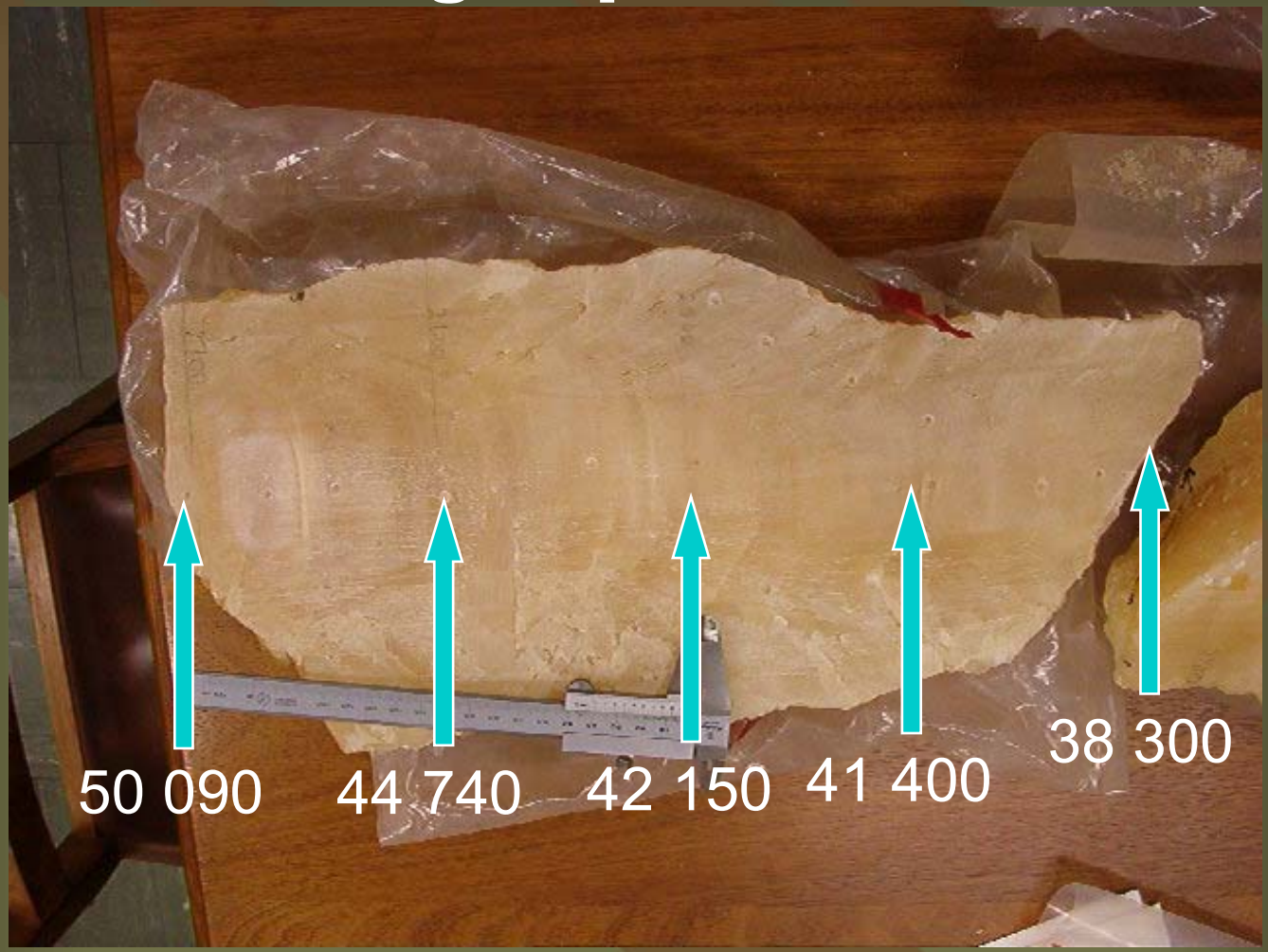
Constructing a 50 000 year $\Delta^{14}C$ record



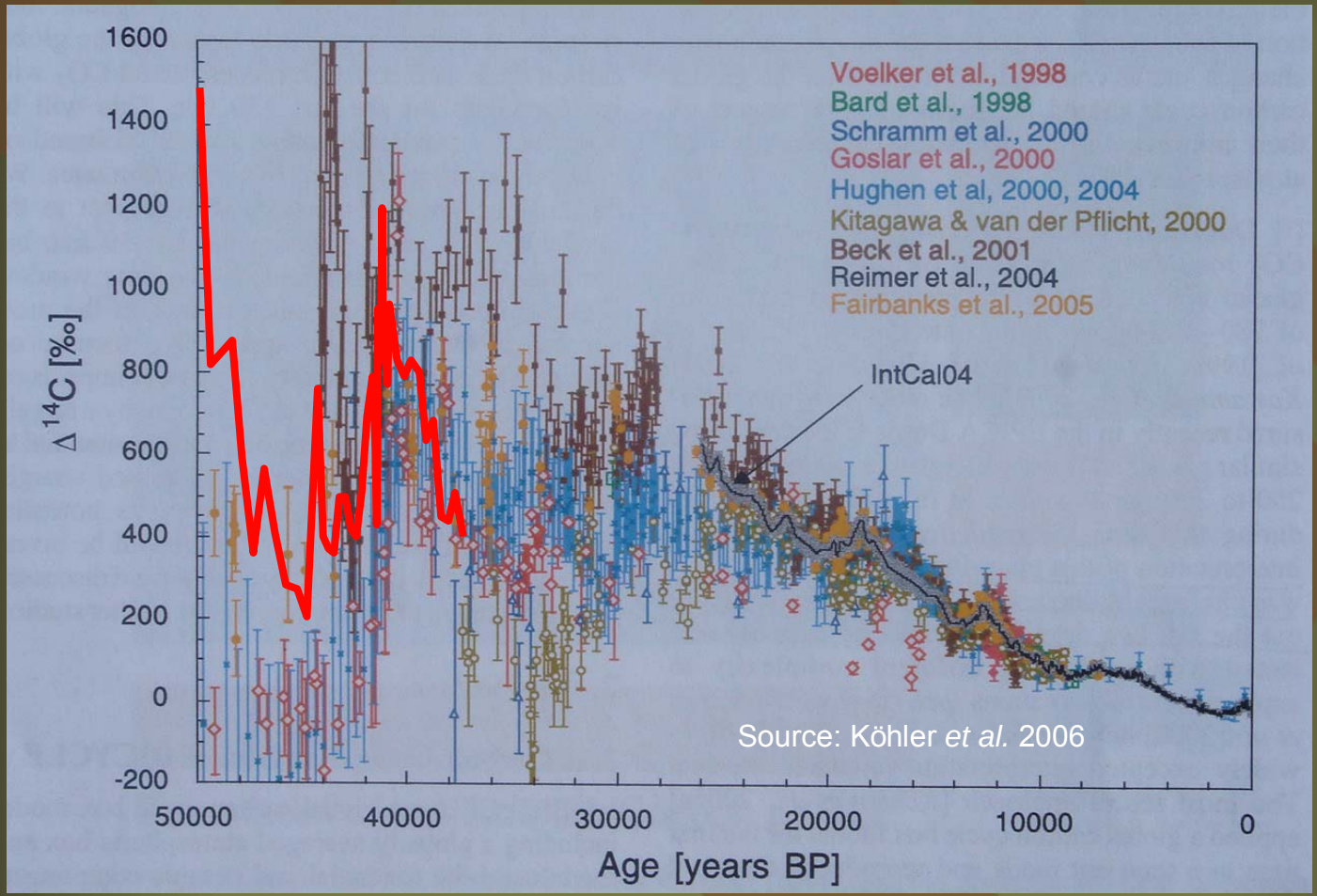
Cango Speleothem



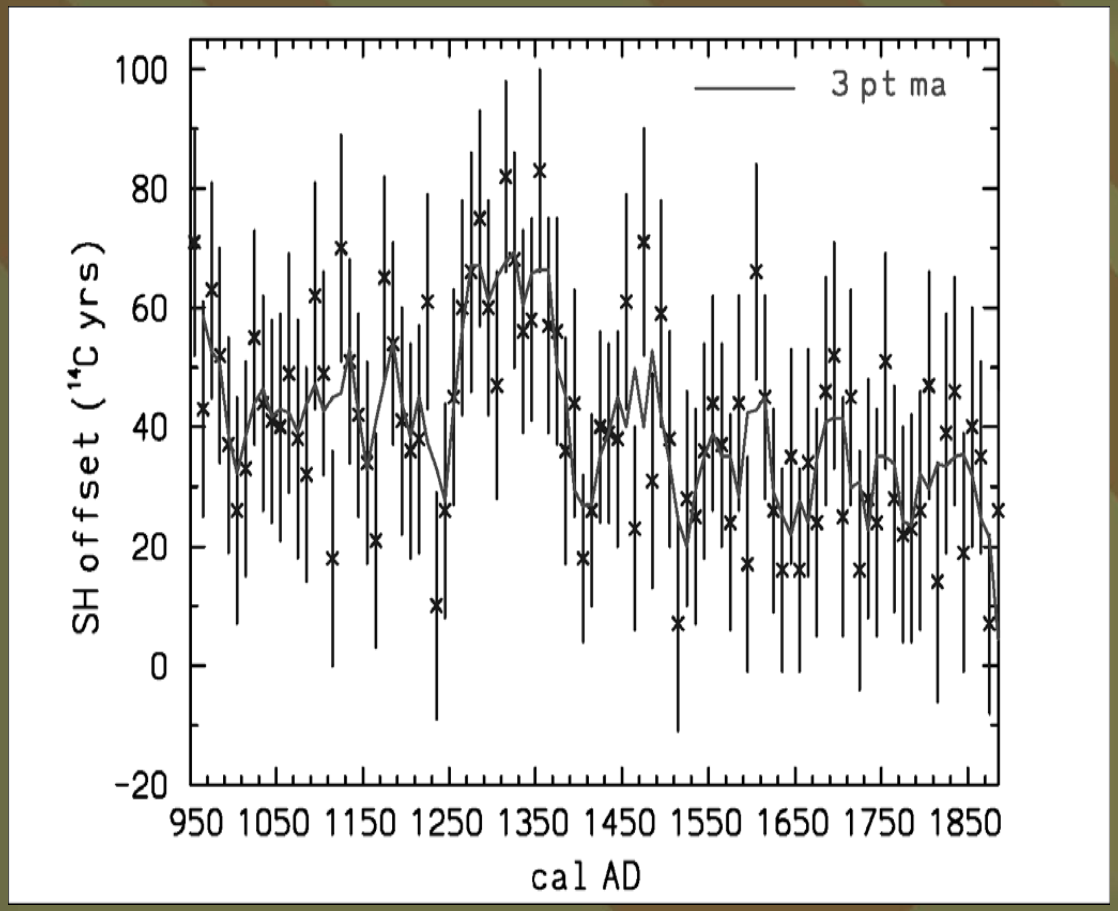
Cango Speleothem



Constructing a 50 000 year $\Delta^{14}C$ record



Evidence for an Oceanic Reservoir Effects

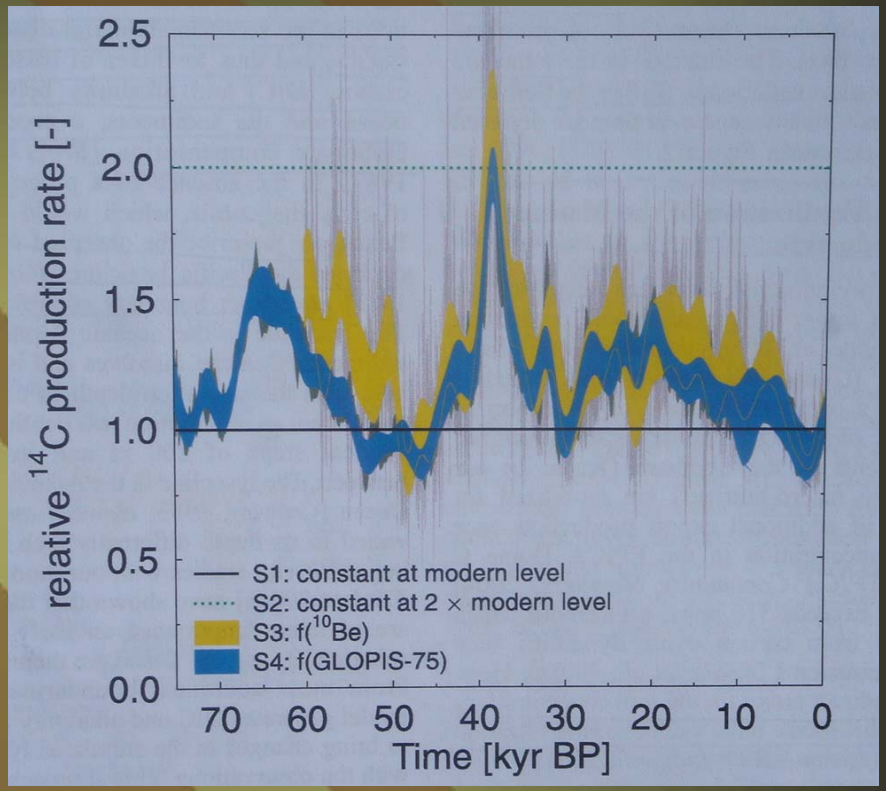


Source: McCormac *et al.* 2002 Radiocarbon

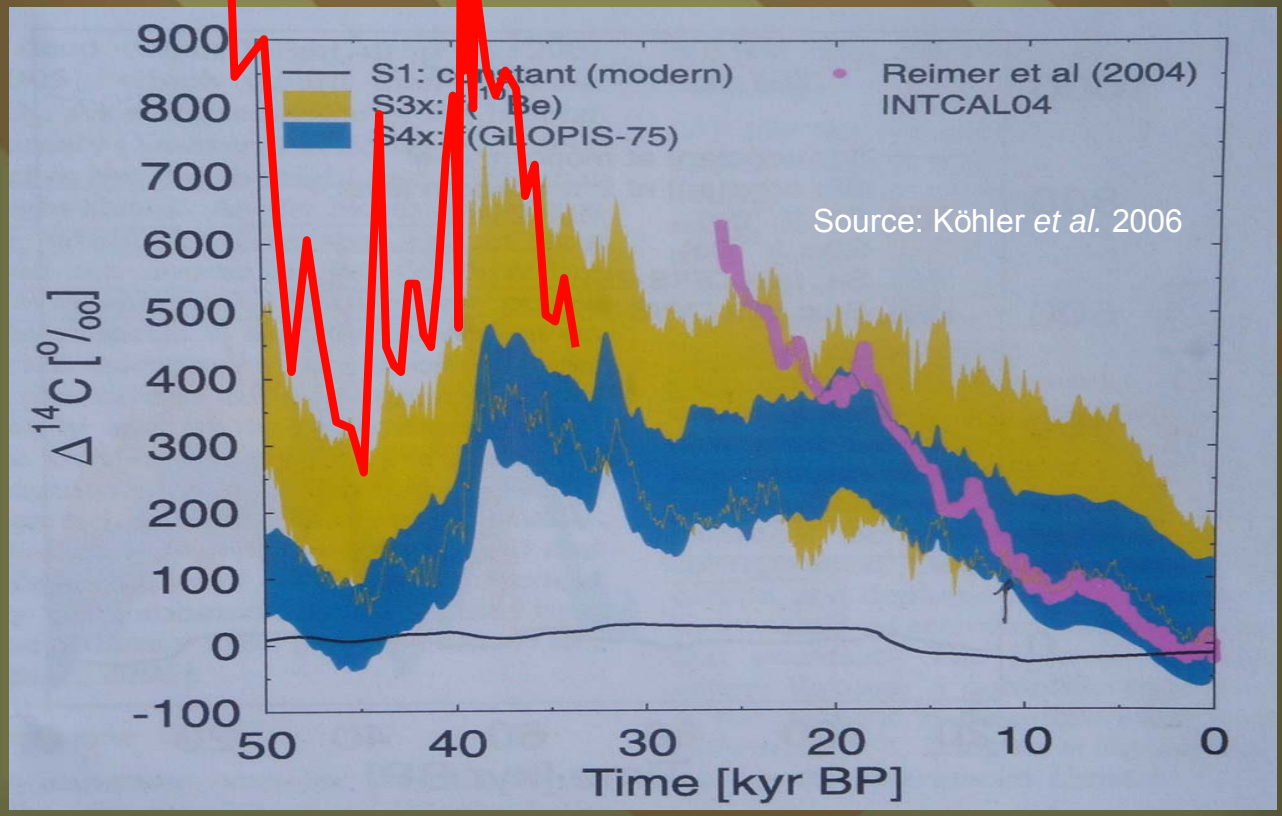
Coupled ocean atmosphere models for $\Delta^{14}C$

Köhler *et al.* 2006:

^{14}C production scenarios
Fe fertilisation of the oceans
Ice core [CO_2]
Ice core $\delta^{13}C$
Ocean circulation



Coupled ocean atmosphere models for $\Delta^{14}C$



Correlation and Causation?

THE CYCLE OF ICE AGES