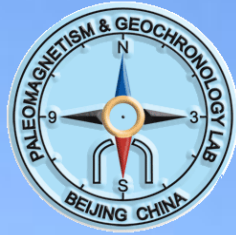


MagIC 5th March, 2014

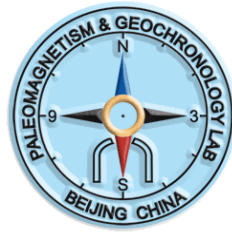


Biomagnetic response to the Holocene Climate Optimum: evidence from Dali Lake, North China

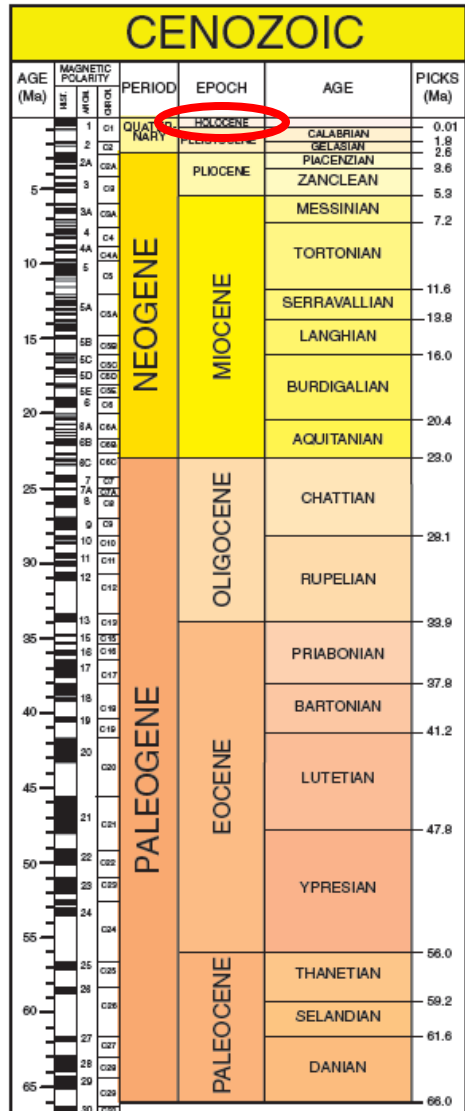
Suzhen Liu, Chenglong Deng, Jule Xiao, Jinhua Li, Greig A. Paterson,
Liang Yi, Huafeng Qin, Yongxin Pan, Rixiang Zhu

PGL, IGGCAS, Beijing

MagIC 5th March, 2014



- Introduction
- Setting and samples
- Results
- Discussion
- Conclusions



1. Evolution of human civilization

e.g. Climate deterioration ~collapse of Classic Maya culture
(Hodell et al., 1995)

2. Paleoclimatic records, especially Holocene

~analogue for predicting future changes (Bradley, 2000)

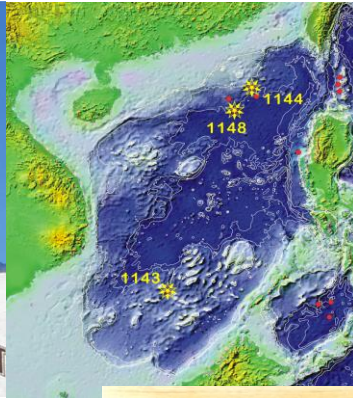
e.g. global warming or another cooling trend



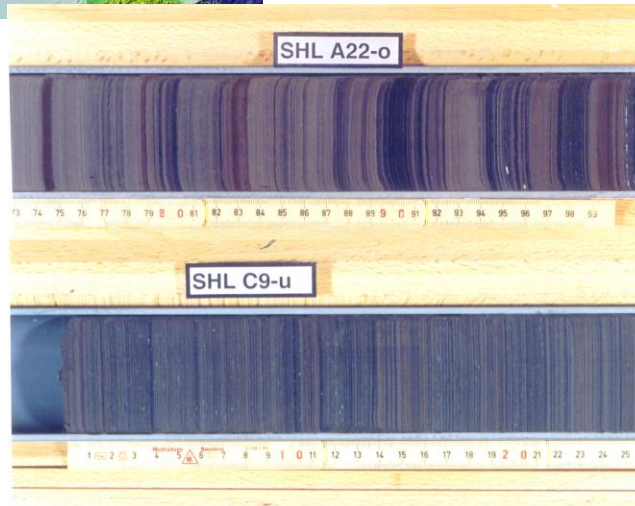
—Environmental magnetism in lake sediments



ODP 184



stalagmite



lake sediments

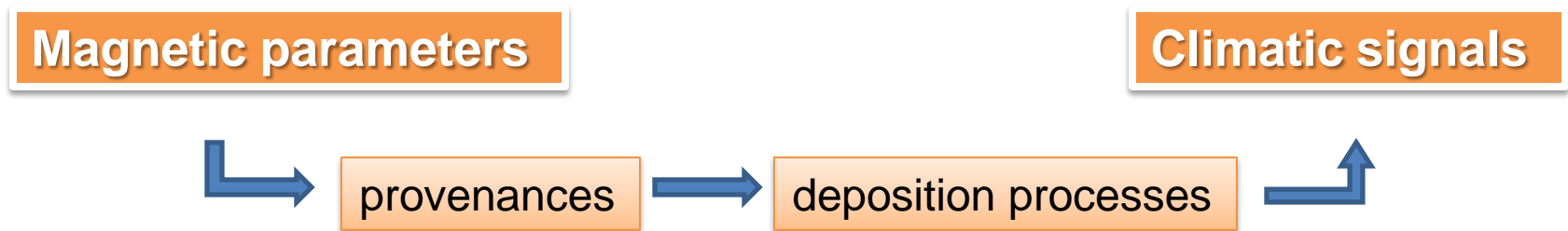
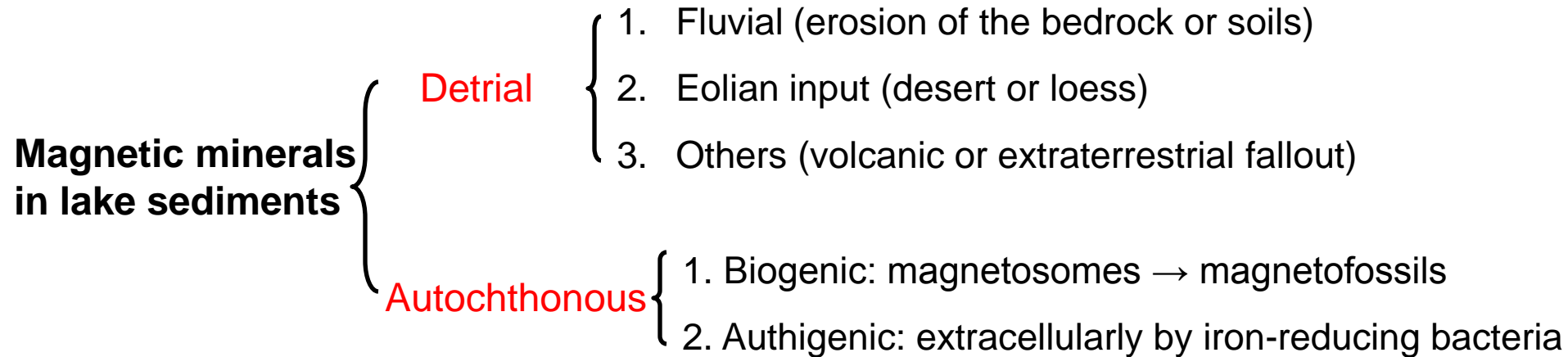


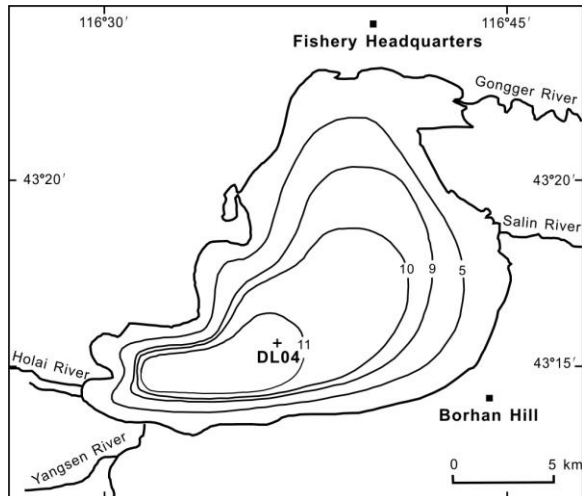
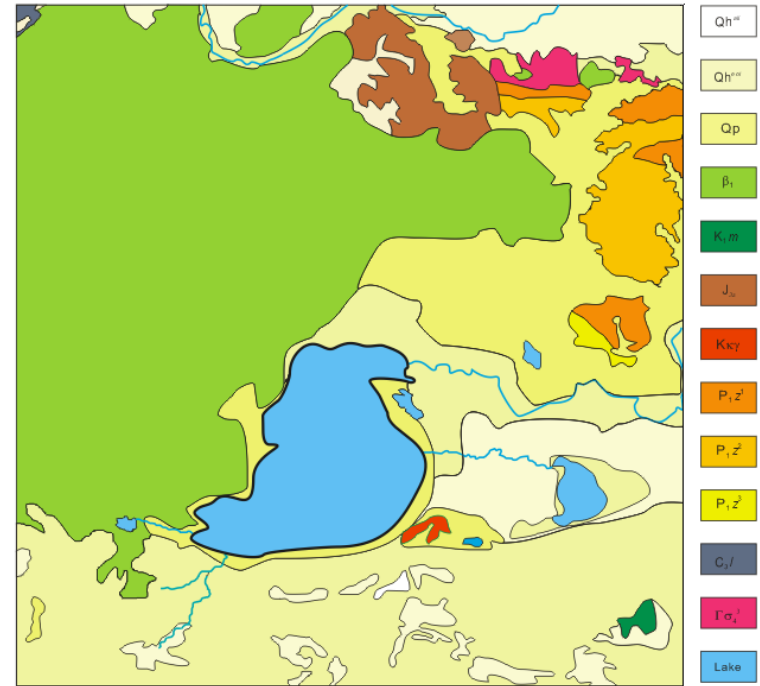
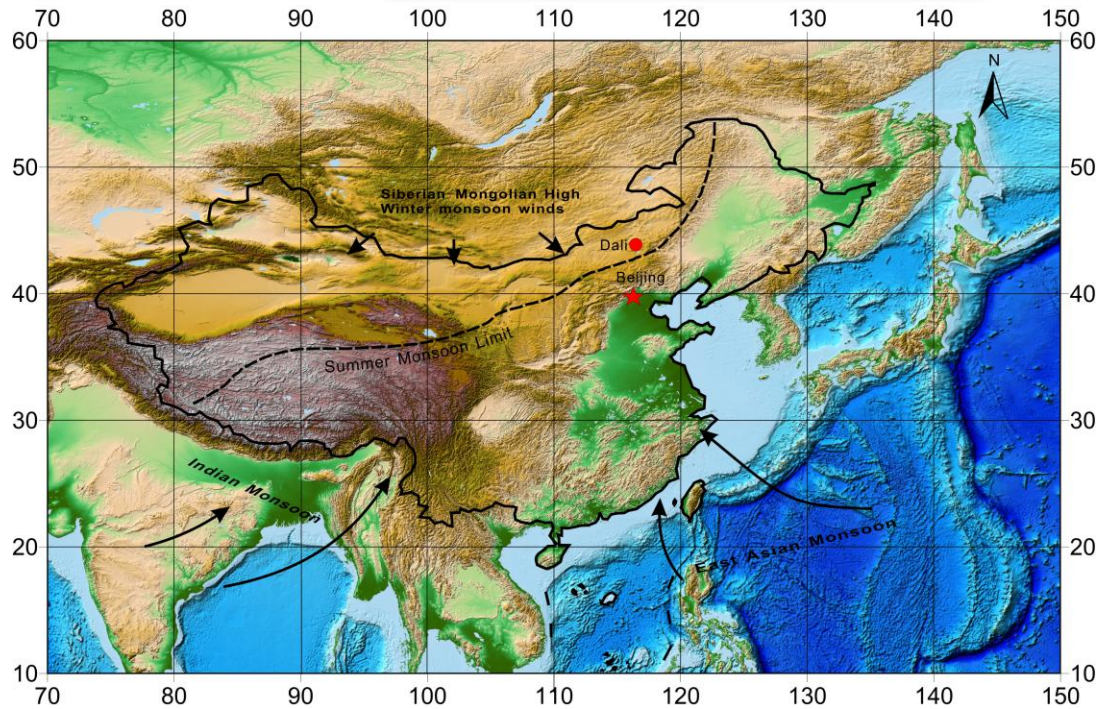
ice cores



树轮样本

tree rings

—Environmental magnetism in lake sediments

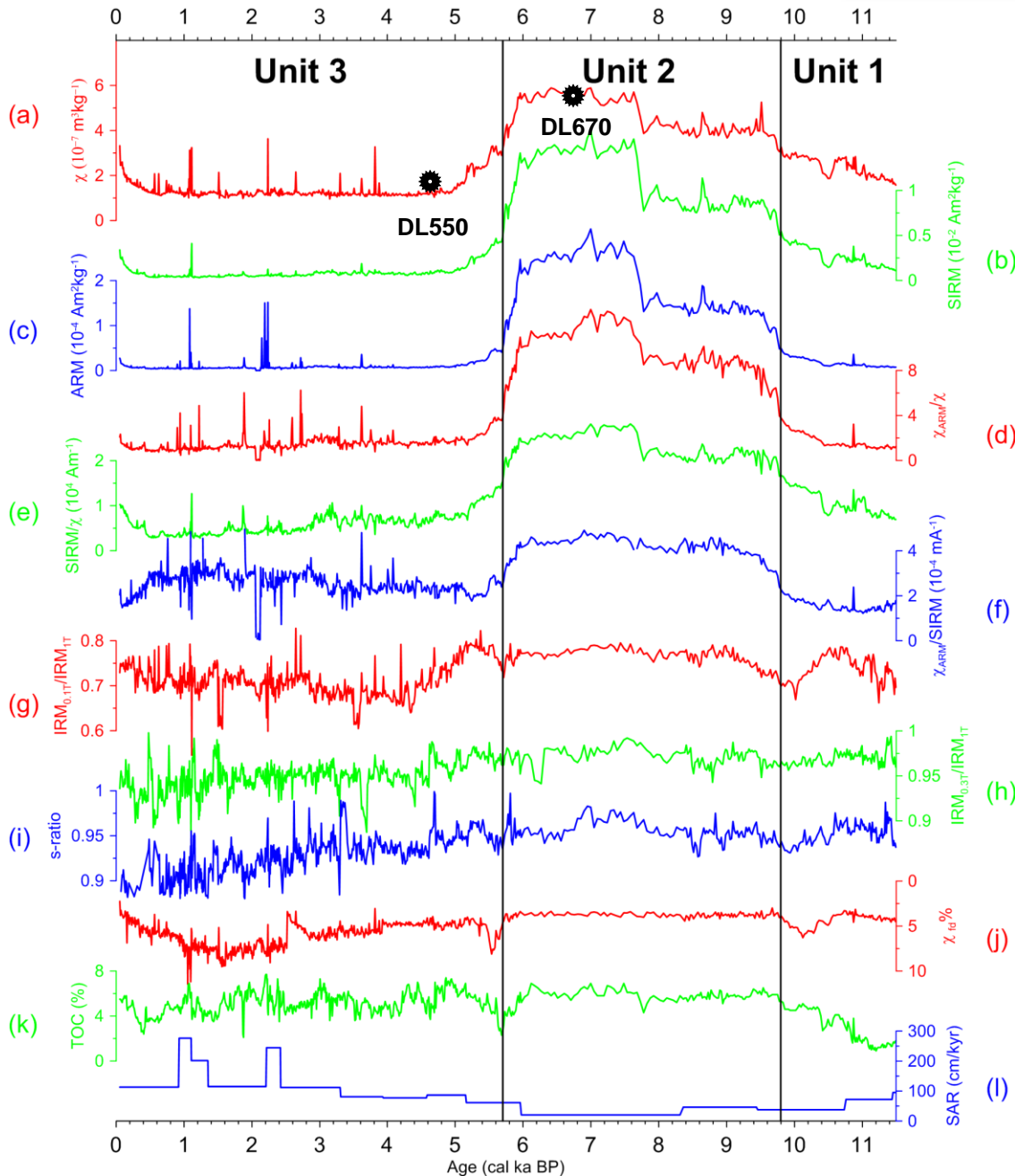


- On the monsoon limit
- Basalt and desert
- Drilling at the depocenter





Upper 8.5 m
(850 unoriented samples)



Unit 1

11.5-9.8 ka (8.50-7.63 m)

Detrital input

Unit 2

9.8-5.7 ka (7.63-6.33 m)

Biomagnetic magnetofossils

DL670 (6.7m, 6.95 ka BP)

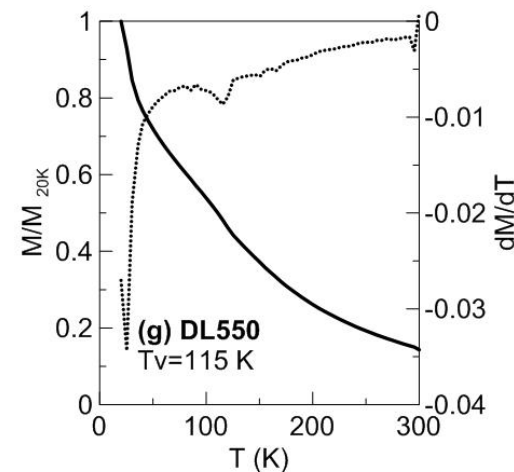
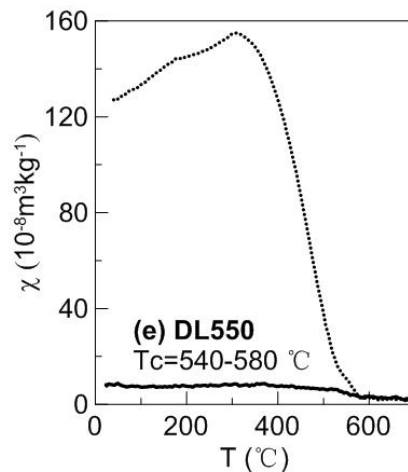
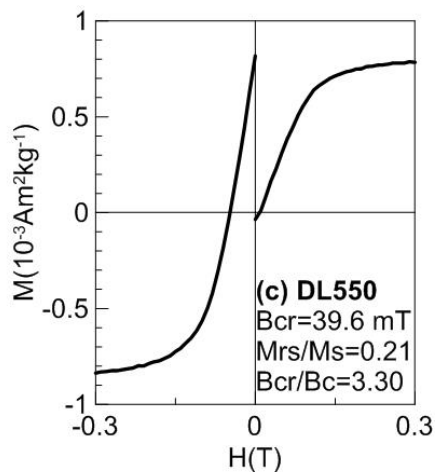
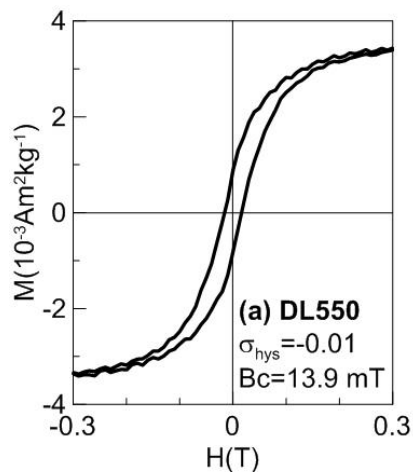
Unit 3

5.7-0 ka (6.33-0 m)

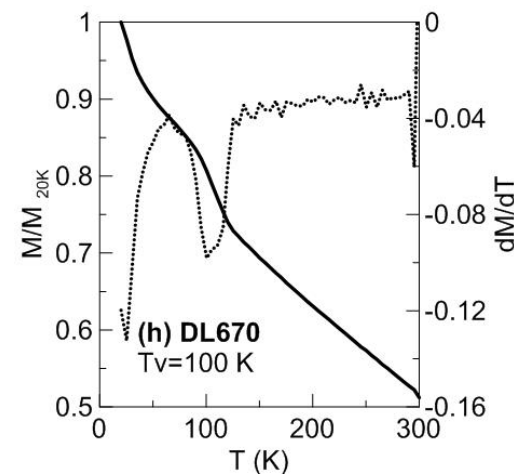
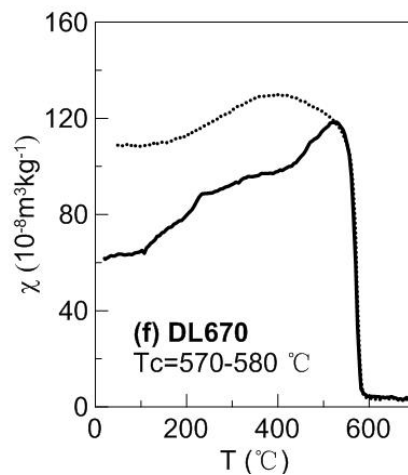
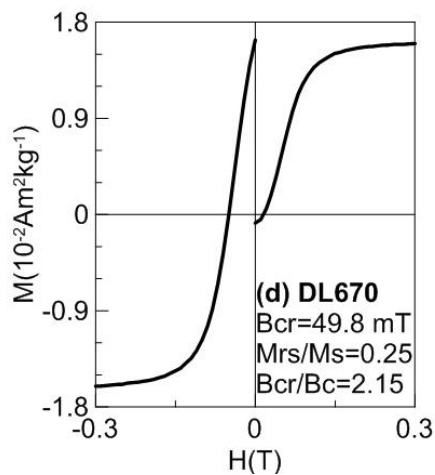
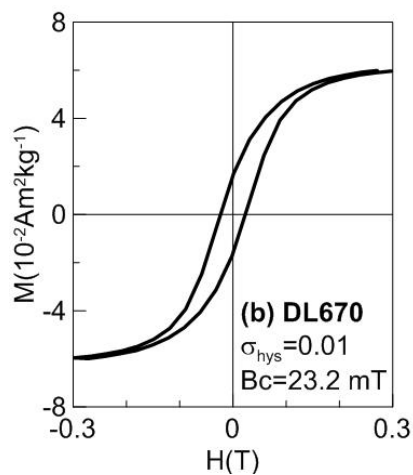
Detrital input

DL550 (5.5m, 4.6 ka BP)

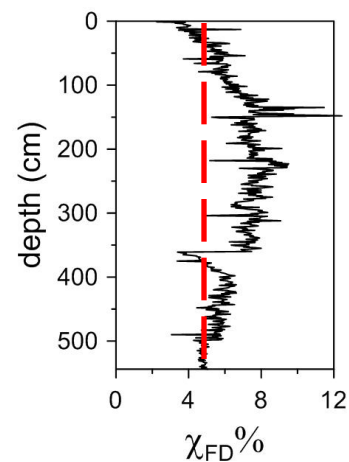
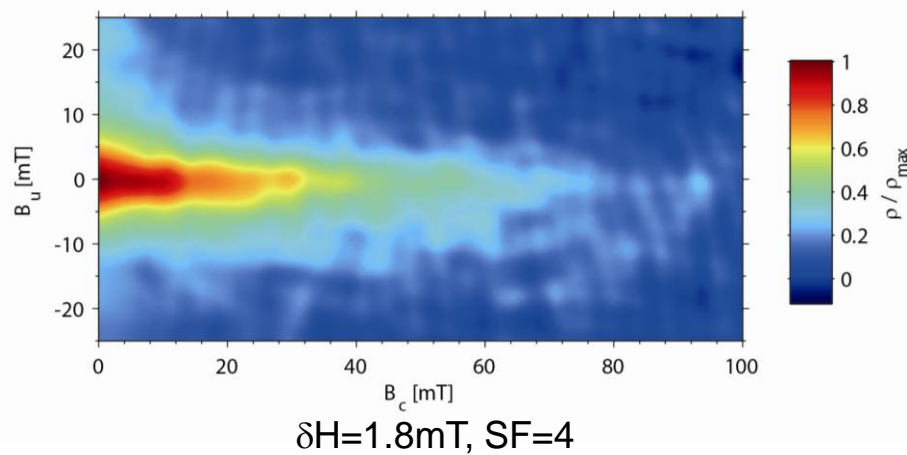
Unit 3 (DL550)



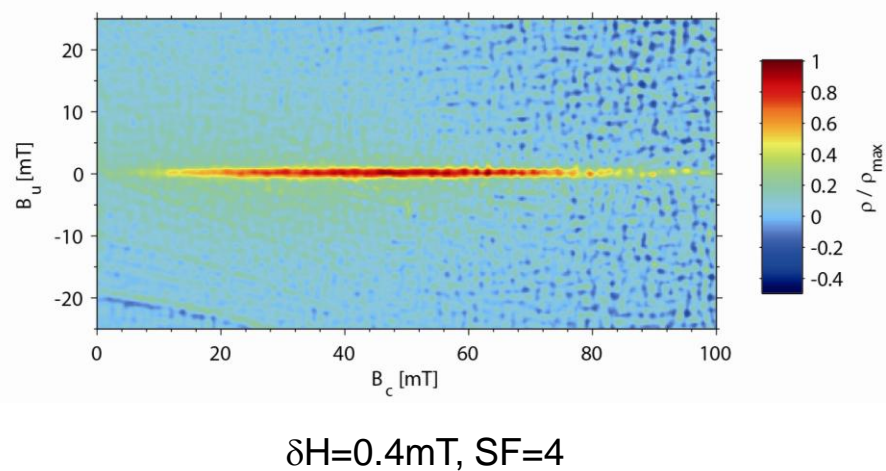
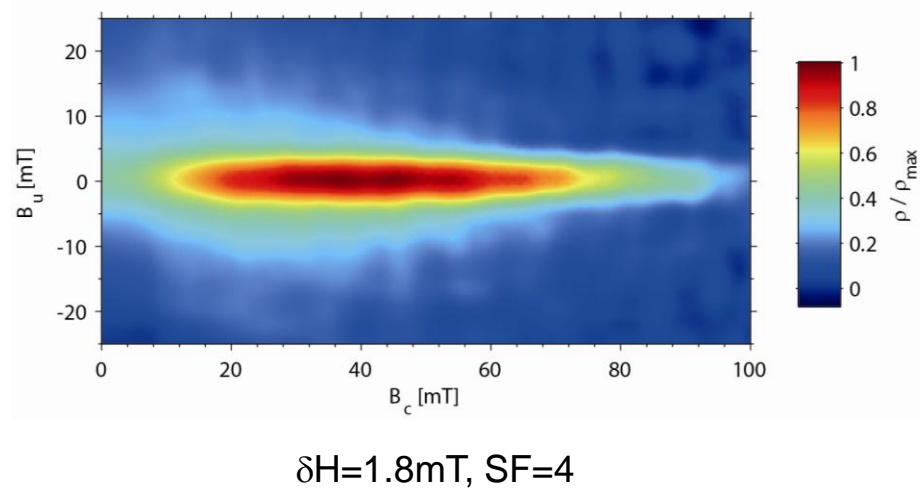
Unit 2 (DL670)



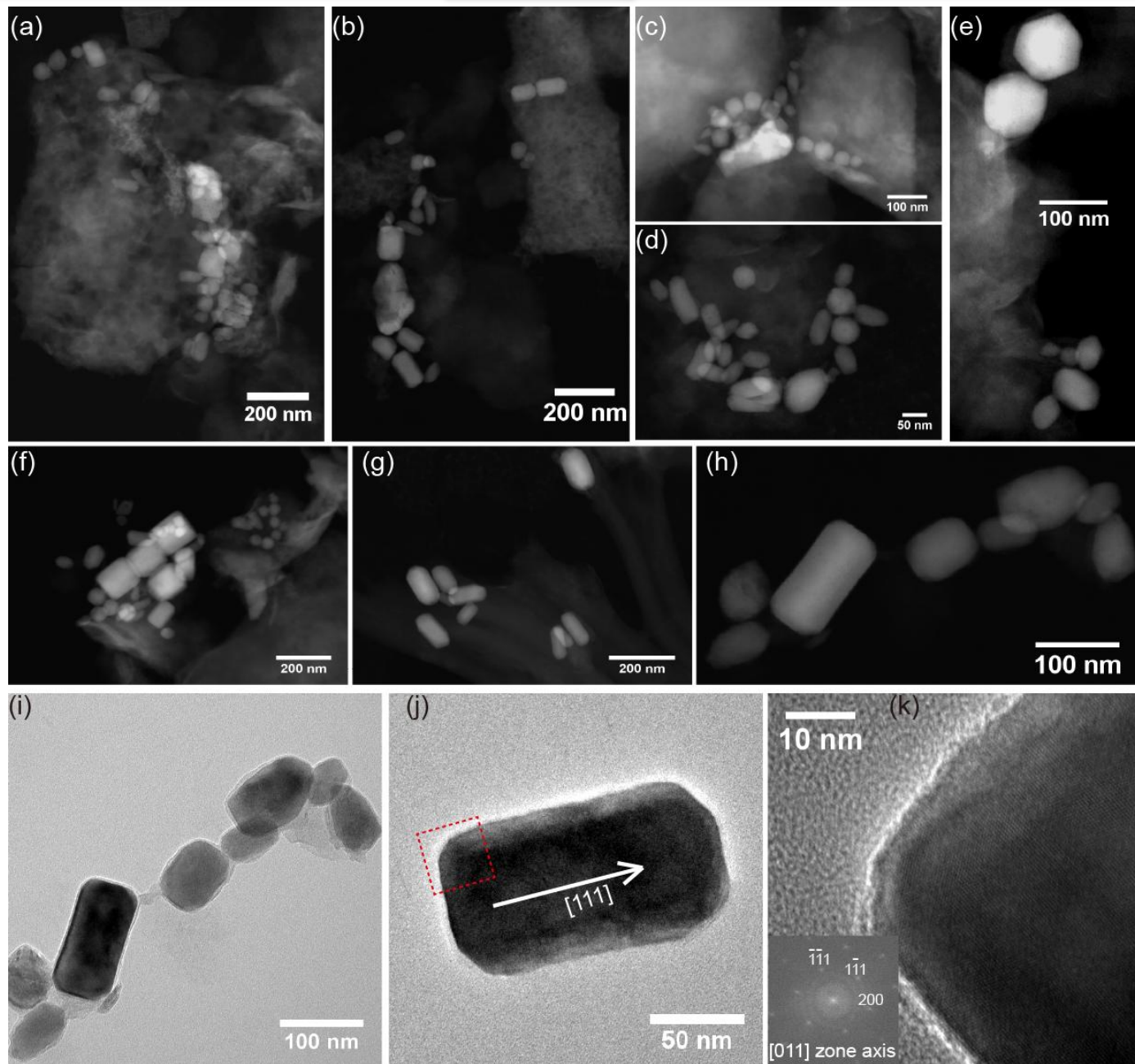
Unit 3 (DL550)

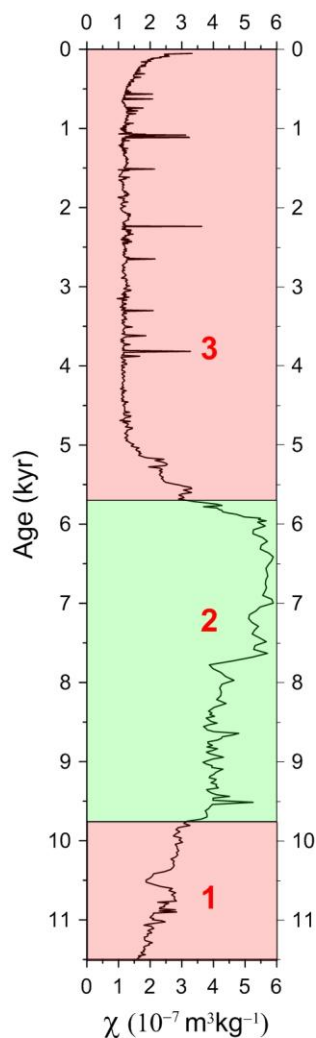


Unit 2 (DL670)



Unit 2 (DL670)





Unit 1 & 3

SP and SD or PSD magnetite
detrital input



provenance



processes



Paleoclimate ??



Unit 2

SD magnetite
biogenic magnetofossils

—Implication of magnetofossils

- Abundance of MTB

- *Higher temperature*

- facilitating the development of suboxic conditions

- *Increased TOC content*

- necessary for magnetotactic bacterial metabolism

- *More iron input* due to enhanced bedrock erosion

- fertilizing bioproductivity and biomineralization

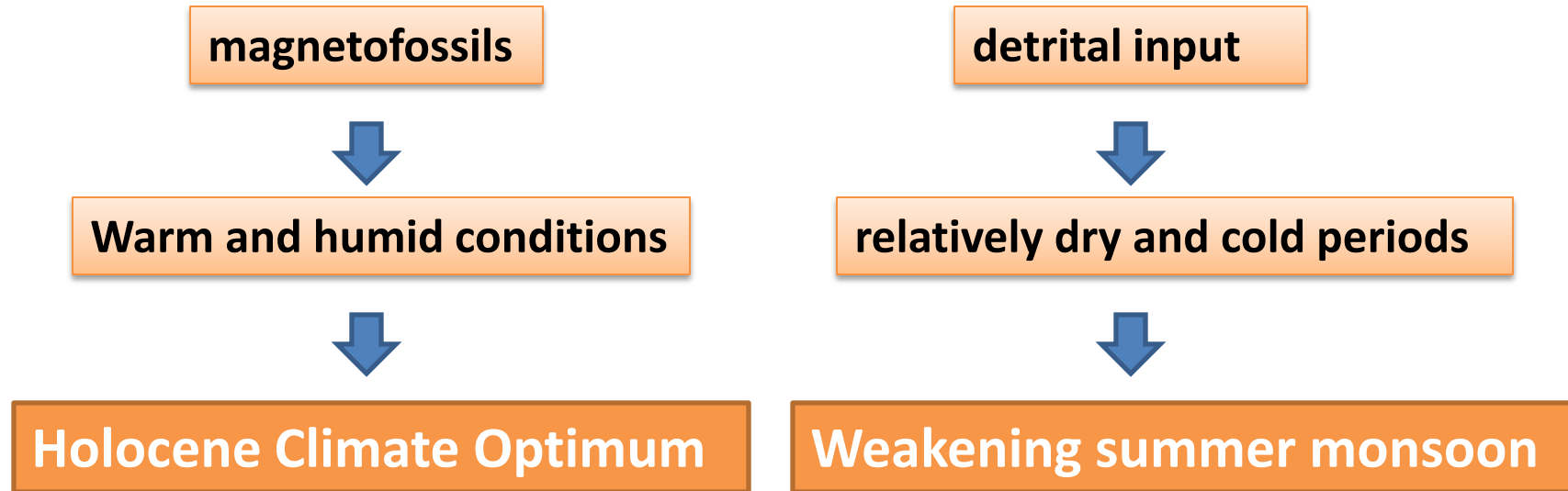
- Good preservation of magnetofossils

- 20-276 cm/ kyr in Dali Lake, compared to pelagic carbonates (<10 cm/ kyr)

- shortened residence time of magnetosomes in the reductive zone

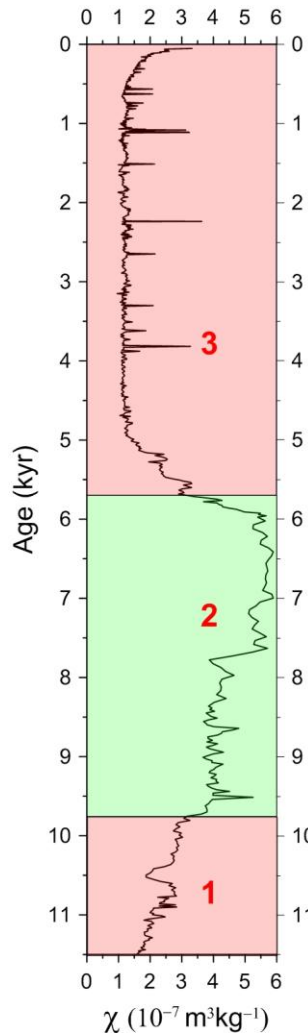
(Kopp et al., 2007; Roberts et al., 2011; Abrajevitch and Kodama, 2011)

— Implication of magnetofossils



First biogenic magnetic records for the Holocene Optimum in the arid areas in North China

— Implication of magnetofossils



Asynchronous Holocene optimum of the East Asian monsoon
(An et al., 2000)



Controversial time constrains

← 5.7 ka BP

The drying event at around 5.7 ka BP might have triggered the transformation from biogenic to detrital magnetic signals (thus terminating the Holocene Optimum)

← 9.8 ka BP

—Implication of magnetofossils

Weakened East Asian Monsoon

at ~ 5.7 ka BP (this study)

at ~ 6 ka BP (Guo et al. 2010)

Weakened Indian Monsoon at ~ 5.5 ka BP

represented by higher magnetic concentration

(Duan et al., 2014)

Weakened African Monsoon at ~ 5.5 ka BP

with the abrupt termination of the African Humid Period

(deMenocal et al., 2000)

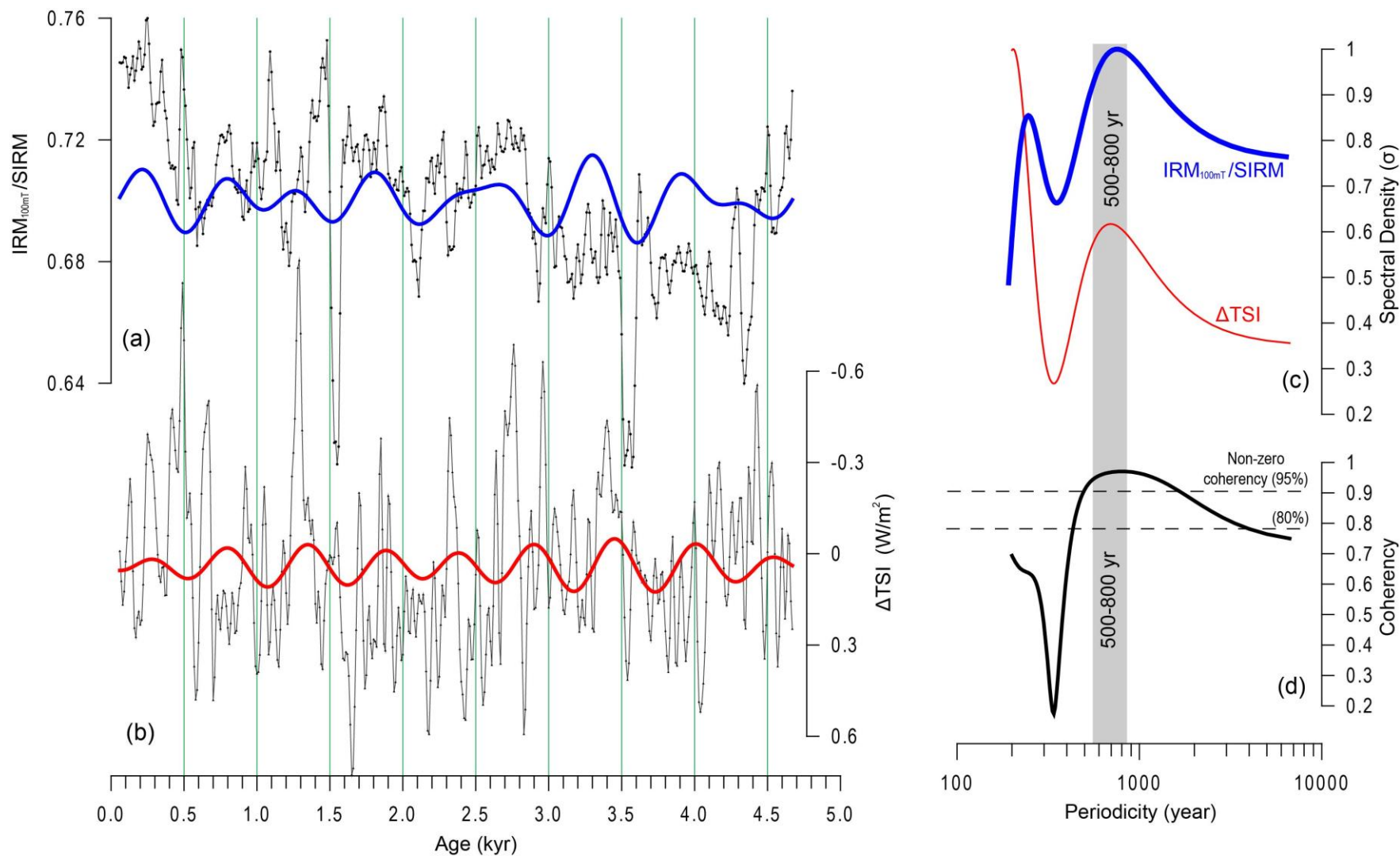
Westerly jet stream moved to equator at ~ 6 ka BP

reflected by maximum eolian flux to the Pacific

(Rea et al., 1988)

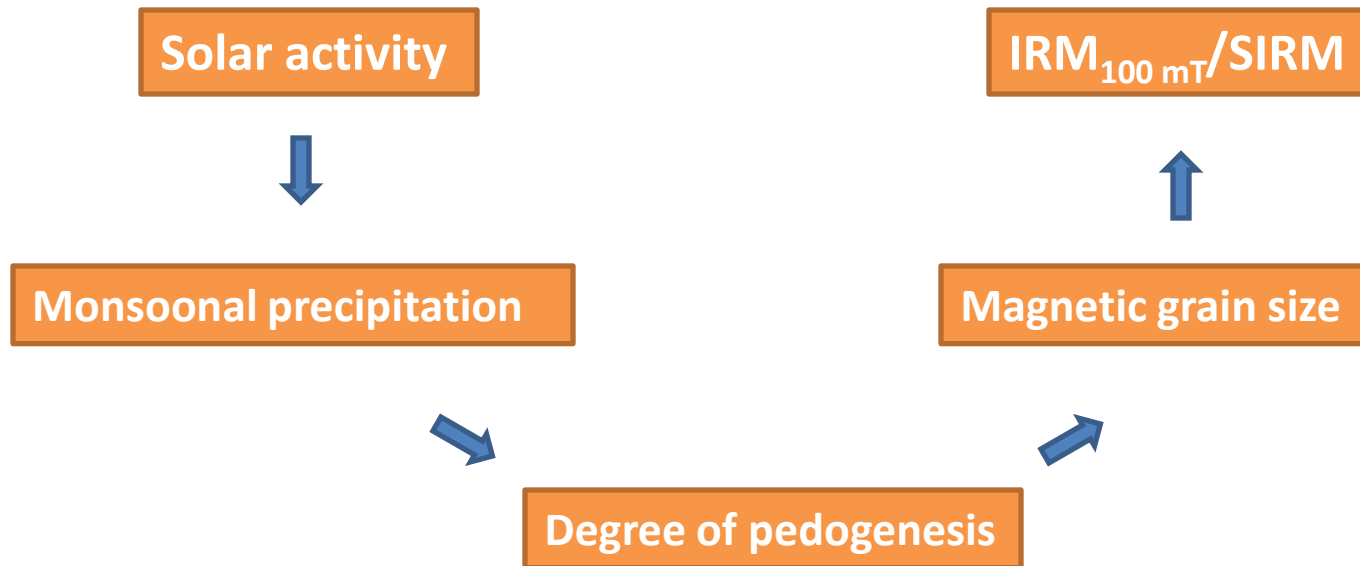
**A global
signal??**

—Paleoclimate periodicity during the late Holocene



—Paleoclimate periodicity during the late Holocene

Soil-erosion model



1. The Holocene sediment core can be divided into three units, based on distinctive magnetic behavior. The units are dominated by **biogenic and detrital magnetic minerals** respectively and thus respond to paleoclimate in different ways.
2. Unit 2 consists large amount of **magnetofossils**. This is explained by the warm and humid conditions during middle Holocene, which can provide higher temperature, increased TOC and iron into the lake.
3. This study provides the first biogenic magnetic records of the Holocene Optimum in arid areas in North China. The biomagnetic signals are characteristic with an abrupt decrease to nearly zero at around **5.7 ka BP**, which may reflect the widespread drought event due to **weakening monsoon** .
4. Magnetic minerals in Unit 1 and 3 are mainly **detrital** input. Spectral analysis of Unit 3 suggests a periodicity of 500-800 years, indicating **solar activity** as the main driving force through monsoonal precipitation during the late Holocene.



谢谢!

