This article presents magnetic data of a 300-m-thick Mio-Pliocene red clay and Quaternary loess-paleosol sequence near Chaona town in the Central Chinese Loess Plateau. Detailed magnetostratigraphy shows that the aeolian red clay began to accumulate at ca. 8.1 Ma. Here, we presented a high-resolution rock magnetic data at 20–40 cm intervals within 4.5–8 ka span per sample of this section, which has been published in Song et al. (2014) [1] and (2017) [2]. The dataset including the following magnetic parameters: mass magnetic susceptibility ($\chi$), frequency-dependent susceptibility ($\chi_{fd}$), saturation magnetization ($M_s$), saturation remanent magnetization ($M_{r}$), coercive force ($B_c$), remanent coercivity ($B_{cr}$), saturation isothermal remanent magnetization (SIRM) and S-ratio. Magnetic susceptibility and hysteresis parameters were measured at Lanzhou University and Kyoto University, respectively. This data provides a high-resolution rock magnetic evidences for understanding East Asia Monsoon change, Asian interior aridification and tectonic effect of the uplift of the Tibetan Plateau since middle Miocene period.

© 2017 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
### Specifications Table

| Subject area                  | Geology                                                                 |
|------------------------------|--------------------------------------------------------------------------|
| More specific subject area   | Quaternary geology and paleoclimate                                     |
| Type of data                 | graphs, figures                                                          |
| How data was acquired        | Bartington MS2 susceptometer, 2 G cryogenic magnetometer (Model 760); Alternating Gradient Magnetometer Micromag™ 2900 model. |
| Data format                  | Raw and analyzed.                                                        |
| Experimental factors         |                                                                           |
| Experimental features        | Magnetic susceptibilities were measured using a Bartington MS2 susceptometer at frequencies of 470 Hz and 4700 Hz. The magnetic remanence was measured on an American DSM2 spinner magnetometer or 2 G cryogenic magnetometer (Model 760). Progressive alternating field demagnetization with 11–18 steps were carried out for most of the samples at 2–10 mT intervals to 70 mT, and progressive thermal demagnetization was done for some typical samples at 20–100 °C intervals in about 22 steps from a room temperature to 710 °C; and Magnetic hysteresis parameters were determined by an Alternating Gradient Magnetometer Micromag™ 2900 model. |
| Data source location         | 35°06'N, 107°12'E; Chaona town, Lingtai County, Gansu Province, China |
| Data accessibility           | Data are within this article and related references                     |
| Related research article     | Song et al. 2005; 2007; 2014; 2017.                                      |

### Value of the Data

- Provide a high-resolution rock magnetic record of the last 8 Ma for local or global environmental changes comparison.
- It is helpful to understand the East Asia Monsoon revolution and Asian interior aridification.
- Provide some clues for understanding the uplift process of the Tibetan Plateau and its effects during late Cenozoic period.
- Useful to researchers and experts working in environmental magnetism, paleoclimate change, past global changes, Quaternary geology and other related fields.

### 1. Data

The Late Cenozoic red clay-loess-paleosol sequence in the Chinese Loess Plateau provides a high-resolution record of paleoclimatic and tectonic changes in Asian. Detailed magnetostratigraphy of a 300-m-thick late Miocene-Pliocene red clay and Quaternary loess-paleosol sequences near Chaona town in the central Chinese Loess Plateau shows that the red clay began to accumulate at ca. 8.1 Ma [3, 4]. Different time scales based on astronomically tuning [5] or independent untuning grain-size age models [1, 6] were established. During the past decade, grain size [7], the pollen [8, 9], carbonate [10], and heavy mineral [11–13] content, together with the magnetic susceptibility enhancement mechanism [14–16], and their palaeoenvironmental significance [17–19], have been investigated.

Here, we presented a high-resolution rock magnetic data at 20–40 cm intervals within 4.5–8 ka span per sample in this Section [1, 2]. The dataset including the following magnetic parameters: mass magnetic susceptibility ($\chi$), frequency-dependent susceptibility ($\chi_{fd}$), hysteresis parameters including saturation magnetization ($M_s$), saturation remanent magnetization ($M_{rs}$), coercive force ($B_c$) and remanent coercivity ($B_{cr}$), Saturation isothermal remanent magnetization (SIRM) and $S$-ratio.
Magnetic susceptibility ($\chi$) and SIRM are function of magnetic mineralogy, concentration and granulometry. Paleosol layers developed under warm and wet interglacial periods have relatively higher both $\chi$ and $\chi_{fd}$ because of stronger pedogenesis in the Chinese Loess Plateau, they have widely been employed as proxies of East Asian summer monsoon intensity. The shapes of the hysteresis loops may be an indicator of the degree of pedogenesis. $M_r$ and $M_s$ are closely related to the type and content of magnetic minerals. Higher $M_r$ and $M_s$ values indicate an increase in ferrimagnetic minerals, such as magnetite and maghemite, and lower values imply the absence of strongly ferrimagnetic minerals. The high coercivity ($B_c, B_{cr}$) may imply the presence of antiferromagnetic goethite and hematite. Rock magnetic data show that the loess layers are characterized by relatively high coercivity ($B_c$ and $B_{cr}$), lower magnetic susceptibility ($\chi, \chi_{fd}$), and the paleosol layers are characterized by relatively high $\chi, \chi_{fd}$ and SIRM. S-ratio is a good indicator of the proportion of magnetite to hematite, higher S-ratio means more abundant concentration of magnetite than hematite.

Based on the magnetic data, we reconstructed the history of the East Asia monsoons during the last 8 Ma and its possible driving mechanism [1,2,6]. We also explored the middle Pleistocene climate transition in this section, which began at ~1.26 Ma and was completed by ~0.53 Ma [1]. Our work also indicated that the variations of both the East Asian Summer Monsoon and Winter Monsoon before 4.3 Ma were closely related to global cooling and that the intensified Summer Monsoon during the late Pliocene was primarily caused by tectonic events, including the gradual closure of the Panama Seaway and the uplift of the Tibetan Plateau, rather than by global cooling [2].

2. Experimental design, materials, and methods

2.1. Materials

The Chaona section is located at Zhengjiashizi Village (107°13'E, 35°02'N) about 5 km south from Chaona Town of Lingtai County, Gansu Province. The section is composed with 175 Quaternary loess-paleosol sequence and 125 late Miocene-Pliocene red clay sequence with a paleomagnetic age 8.1 Ma [3,4]. More than 400 sets of oriented block samples at 0.2–2 m interval for paleomagnetic measurements and over 2600 discrete samples at 0.10–0.2 m interval for various proxies analyzes were collected [1,2].

![Fig. 1.](image-url) Progressive alternative (upper) and thermal (lower) demagnetization of some typical samples.
2.2. Magnetochronology

Each oriented bulk sample was split into three sets of parallel cubic specimens with a dimension of $2 \times 2 \times 2$ cm for paleomagnetic analysis. The paleomagnetic measurement was performed in Lanzhou Geological Institute, and Geology and Geophysics Institute of the Chinese Academy of Sciences, and rechecked in the Paleomagnetism Laboratory of Kyoto University. The magnetic remanence was measured on an American DSM2 spinner magnetometer or 2 G cryogenic magnetometer. 11–18 steps of progressive alternating field demagnetization (AFD) were carried out for most of the samples at 2–10 mT intervals to 70 mT, and progressive thermal demagnetization (ThD) was done for some typical samples at 20–100 °C intervals in about 22 steps from a room temperature to 710 °C (Fig. 1). The magnetochronologic data indicates that bottom age of the section is around 8.1 Ma [3,4].

2.3. Rock magnetic measurements

Magnetic susceptibility and hysteresis parameters were measured at Lanzhou University and Kyoto University, respectively. Magnetic susceptibilities were measured on all air-dried samples using a Bartington MS2 susceptometer at frequencies of 470 Hz (i.e., $\chi''$) and 4700 Hz (i.e. $\chi''$), and $\chi \chi = \chi''$.
(\chi_l + \chi_{hf})/2], \chi_{fd} \{\chi_{fd} = (\chi_{lf} - \chi_{hf})/\chi_{lf} \times 100\} represent the absolute and relative behavior, respectively, of the frequency-dependent susceptibility (Fig. 2).

Magnetic hysteresis parameters (Fig. 3) were measured using an Alternating Gradient Magnetometer (AGM) MicromagTM 2900 model at the paleomagnetism laboratory of Kyoto University, with a maximum field of 1.0 T and a 2 mT increment [1,2]. Saturation magnetization (\(M_s\)), saturation remanent magnetization (\(M_{rs}\)) and coercive force (\(B_c\)) were calculated after removal of the paramagnetic component. Remanent coercivity (\(B_{cr}\)) was measured by applying a forward field of 1.0 T followed by the application of reverse fields of increasing strength and the change in remanence measured at each step. The data enable various interparametric ratios to be calculated using the IRM imparted at a high field (here 1.0 T) and the back IRM value at various reverse field strengths (e.g. −0.3 T). These parameters reflect variations in the coercivity spectrum of the magnetic mineral.

Fig. 3. Representative magnetic hysteresis loops of loess-paleosols (SZ) and red clay (CN) samples from the Chaona section.
assemblage and therefore the mineralogy and grain size. The saturation isothermal remanent magnetization was determined at 1 T (SIRM), −0.1 T (IRM−0.1 mT) and −0.3 T (IRM−0.3T). S-ratio was calculated as $S\text{-ratio} = \left[\frac{-\text{IRM}_{-0.3 \text{T}}}{\text{SIRM}} + 1\right]/2$. Based on paleomagnetic control points and independent untuned time scale, we established a high-resolution magnetic record of Mio-Pliocene red clay and Quaternary loess-paleosol sequence in this section (Fig. 4).

Acknowledgments

This work was supported by Natural Science Foundation of China (NSFC) (nos: 41290253, 40599421, 40202019) and Xi’an Centre of Geological Survey, CGS (CGS Diaosheng [2017]0438).

Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2017.11.059.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2017.11.059.
References

[1] Y.G. Song, X.M. Fang, J.W. King, J.J. Li, I. Naoto, Z.S. An, Magnetic parameter variations in the Chaona loess/paleosol sequences in the central Chinese Loess Plateau, and their significance for the middle Pleistocene climate transition, Quat. Res. 81 (2014) 433–444.

[2] Y.G. Song, X. Fang, X. Chen, Masayuki Torii, N. Ishikawa, M. Zhang, S. Yang, H. Chang, Rock magnetic record of late Neogene red clay sediments from the Chinese Loess Plateau and its implications for East Asian monsoon evolution, Palaeogeogr. Palaeoclim. Palaeoecol. (2017). http://dx.doi.org/10.1016/j.palaeo.2017.09.025.

[3] Y.G. Song, J.J. Li, X.M. Fang, F. Xia, H.M. Dong, Red clay sediment in the central Chinese Loess Plateau and its implication for the uplift of the Tibetan Plateau, J. Mt. Sci. 2 (2005) 137–145.

[4] Y.G. Song, X.M. Fang, J.J. Li, Z.S. An, X.D. Miao, The Late Cenozoic uplift of the Liupan Shan, China, Sci. China. Ser. D 44 (2001) 176–184.

[5] W. Han, X. Fang, A. Berger, Q. Yin, An astronomically tuned 8.1 Ma eolian record from the Chinese Loess Plateau and its implication on the evolution of Asian monsoon, J. Geophys. Res. Atmos. 116 (2011) D24114. http://dx.doi.org/10.1029/2011JD016237.

[6] Y.G. Song, X.M. Fang, M. Torii, N. Ishikawa, J.J. Li, Z.S. An, Late Neogene rock magnetic record of climatic variation from Chinese eolian sediments related to uplift of the Tibetan Plateau, J. Asian Earth Sci. 30 (2007) 324–332.

[7] L. Lü, X. Fang, J.A. Mason, J. Li, Z. An, The evolution of coupling of Asian winter monsoon and high latitude climate of Northern Hemisphere, Sci. China Ser. D 44 (2001) 185–191.

[8] Y. Ma, F. Wu, X. Fang, J. Li, Z. An, W. Wang, Pollen record from red clay sequence in the central Loess Plateau between 8.10 and 2.60 Ma, Chin. Sci. Bull. 50 (2005) 2234–2243.

[9] F.L. Wu, X.M. Fang, Y.Z. Ma, M. Herrmann, V. Mosbrugger, Z.S. An, Y.F. Miao, Pli–quaternary stepwise drying of Asia: evidence from a 3-Ma pollen record from the Chinese Loess Plateau, Earth Planet. Sci. Lett. 257 (2007) 160–169.

[10] X. Chen, X. Fang, Z. An, W. Han, X. Wang, Y. Bai, Y. Hong, An 8.1 Ma calcite record of Asian summer monsoon evolution on the Chinese central Loess Plateau, Sci. China. Ser. D 50 (2007) 392–403.

[11] J.S. Nie, W.B. Peng, A. Moller, Y.G. Song, D.F. Stockill, T. Stevens, B.K. Horton, S.P. Liu, A. Bird, J. Oalmann, H.J. Gong, X.M. Fang, Provenance of the upper Miocene-Pliocene Red Clay deposits of the Chinese loess plateau, Earth Planet. Sci. Lett. 407 (2014) 35–47.

[12] W.B. Peng, Z. Wang, Y.G. Song, K. Pfaff, Z. Luo, J.S. Nie, W.H. Chen, A comparison of heavy mineral assemblage between the loess and the Red Clay sequences on the Chinese Loess Plateau, Aeolian Res. 21 (2016) 87–91.

[13] J. Nie, W. Peng, Automated SEM–EDS heavy mineral analysis reveals no provenance shift between glacial loess and interglacial paleosol on the Chinese Loess Plateau, Aeolian Res. 13 (2014) 71–75.

[14] J. Nie, J.W. King, X. Fang, Enhancement mechanisms of magnetic susceptibility in the Chinese red-clay sequence, Geophys. Res. Lett. 34 (2007) L19705. http://dx.doi.org/10.1029/2007GL031430.

[15] J.S. Nie, Y.G. Song, J.W. King, R. Egli, Consistent grain size distribution of pedogenic magnetite of surface soils and Miocene loessic soils on the Chinese Loess Plateau, J. Quat. Sci. 25 (2010) 261–266.

[16] R. Zhang, C. Necula, D. Heslop, J. Nie, Unmixing hysteresis loops of the late Miocene–early Pleistocene loess-red clay sequence, Sci. Rep. 6 (2016) e29515. http://dx.doi.org/10.1038/srep29515.

[17] J.S. Nie, Y.G. Song, J.W. King, X.M. Fang, C. Heil, HIRM variations in the Chinese red-clay sequence: insights into pedogenesis in the dust source area, J. Asian Earth Sci. 38 (2010) 96–104.

[18] J.S. Nie, Y.G. Song, J.W. King, R. Zhang, X.M. Fang, Six million years of magnetic grain-size records reveal that temperature and precipitation were decoupled on the Chinese Loess Plateau during similar to 4.5–2.6 Ma, Quat. Res. 79 (2013) 465–470.

[19] J.S. Nie, R. Zhang, C. Necula, D. Heslop, Q.S. Liu, L.S. Gong, S. Banerjee, Late Miocene- early Pleistocene paleoclimate history of the Chinese Loess Plateau revealed by remanence unmixing, Geophys. Res. Lett. 41 (2014) 2163–2168.