

1 **SUPPLEMENTARY INFORMATION**

2 **India-Asia collision was at 24°N and 50 Ma: palaeomagnetic proof**  
3 **from southernmost Asia**

4 Jun Meng<sup>1</sup> Chengshan Wang<sup>1\*</sup> Xixi Zhao<sup>2</sup> Rob Coe<sup>2</sup> Yalin Li<sup>1</sup> David Finn<sup>2</sup>

5 1 State Key Laboratory of Biogeology and Environmental Geology (China  
6 University of Geosciences), Beijing 100083, China

7 2 Department of Earth and Planetary Sciences, University of California, Santa Cruz,  
8 CA 95064, USA

9

10 \*Corresponding author: [chshwang@cugb.edu.cn](mailto:chshwang@cugb.edu.cn)

11 First author: [mj.chen2009@gmail.com](mailto:mj.chen2009@gmail.com)

12

13

14

15

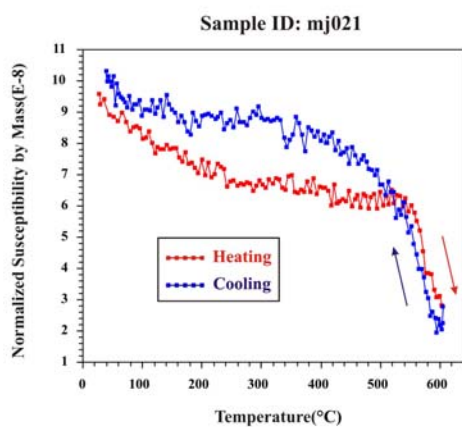
16

17

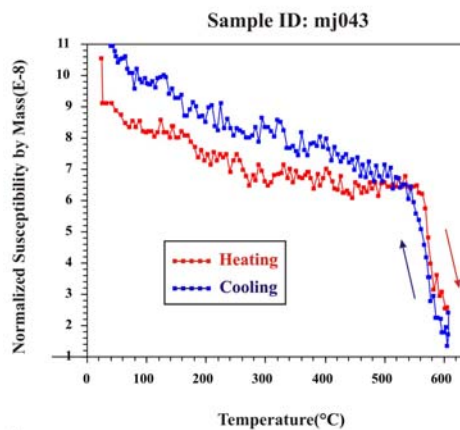
18

19 **Supplementary Figures**

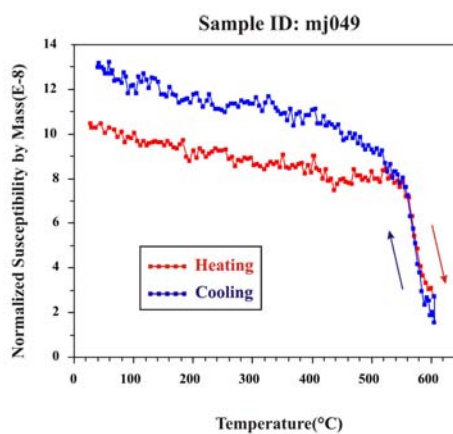
20



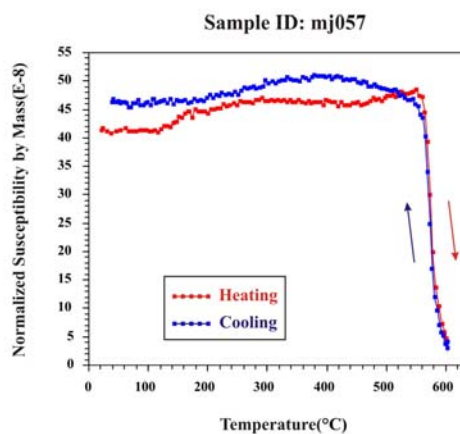
**a**



**b**



**c**

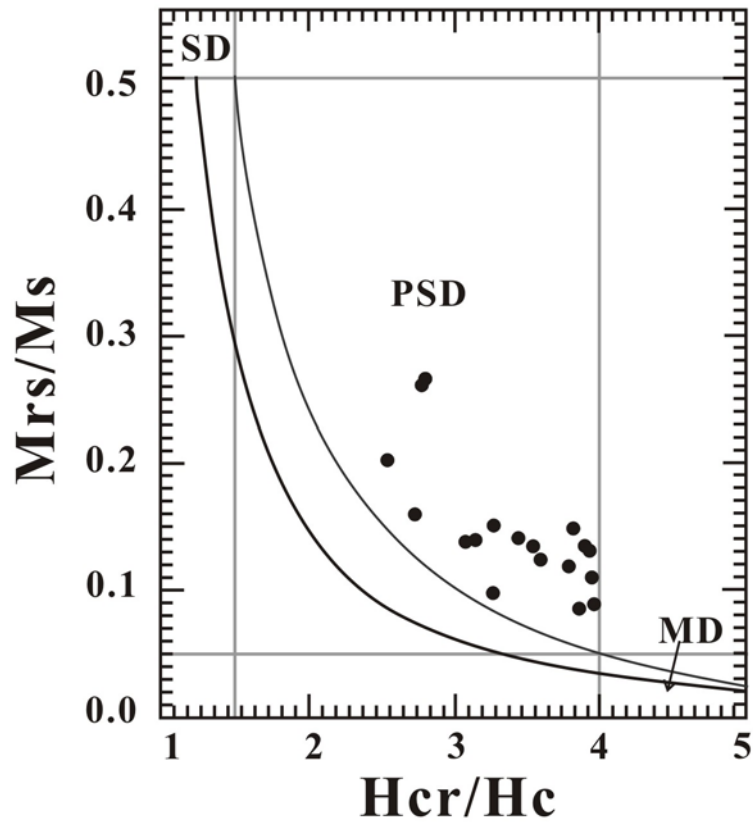


**d**

21

22 **Fig. S1** Normalized susceptibility by mass vs. temperature. All samples

23 heated in an argon environment.

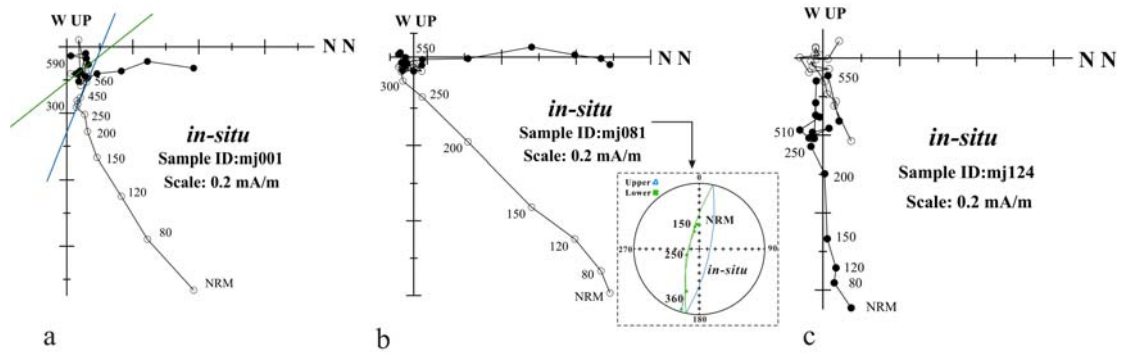


24

25 **Fig. S2** Day plot<sup>1</sup> of hysteresis data, showing the magnetic grain size of  
 26 samples. The straight grey lines mean magnetic grain size fields:  
 27 single-domain (SD), pseudo-single domain (PSD) and multidomain (MD).  
 28 Thick curved solid line is a theoretical mixing curve of MD and uniaxial  
 29 single-domain (SD) magnetite; thin curved line is a mixing curve of MD  
 30 and cubic SD magnetite<sup>2</sup>.

31

Palaeomagnetic demagnetization data-Grade C and D



32

33 **Fig. S3** Representative orthogonal projections of grades C and D  
 34 palaeomagnetic demagnetization data from upper Cuojiangding Group  
 35 plotted in *in-situ* coordinate. Solid (open) circles are the horizontal  
 36 (vertical) plane projections. Scales are in mA/m. Green and blue straight  
 37 lines represent the least-square-best fitting directions of the ChRM. Green  
 38 and blue circle indicate the NRM directions distributed along with the  
 39 great circle in the equal-area projection. See text for description of  
 40 demagnetization behavior.

41

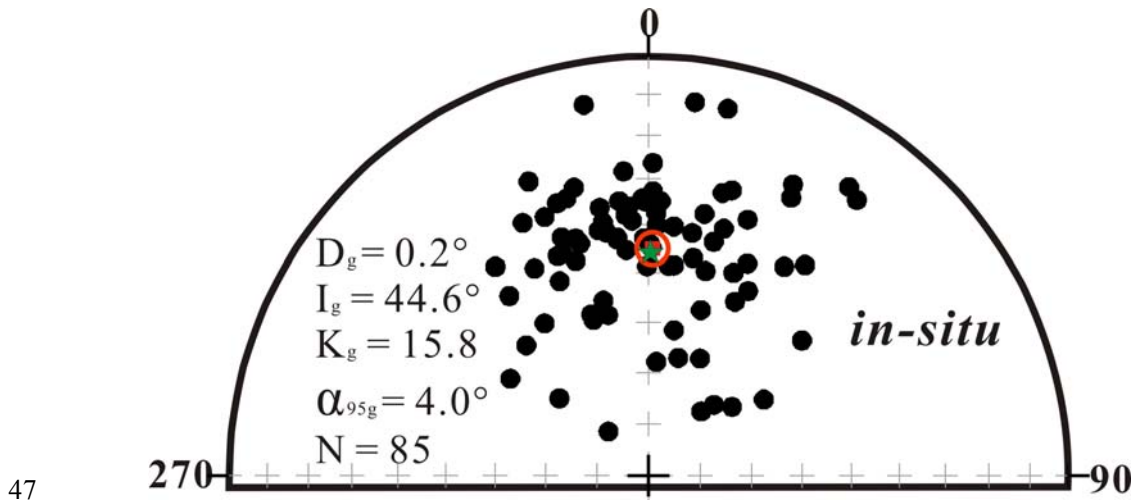
42

43

44

45

46



48 **Fig. S4** Equal-area projections of *in-situ* site mean direction for the low  
 49 temperature component (LTC) from upper Cuojiangding Group. Solid  
 50 black circles indicate lower hemisphere projections. Solid red square  
 51 stands for the site mean direction. Green star presents local geomagnetic  
 52 field.

53

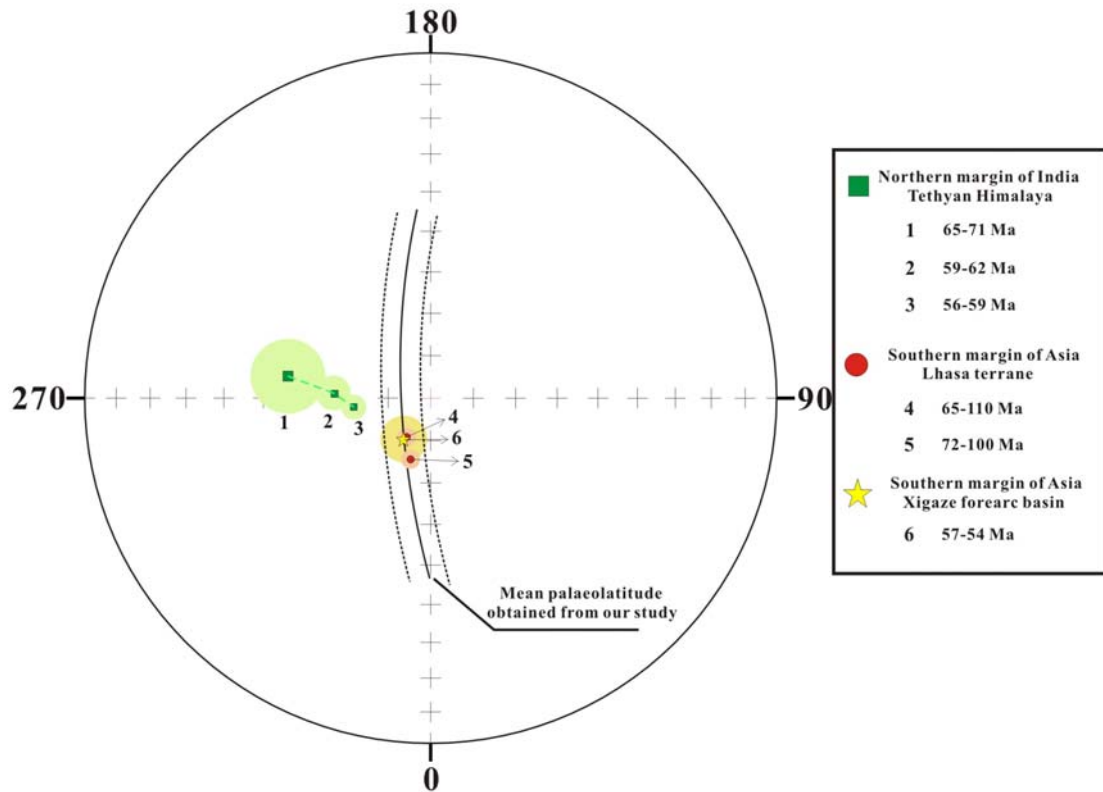
54

55

56

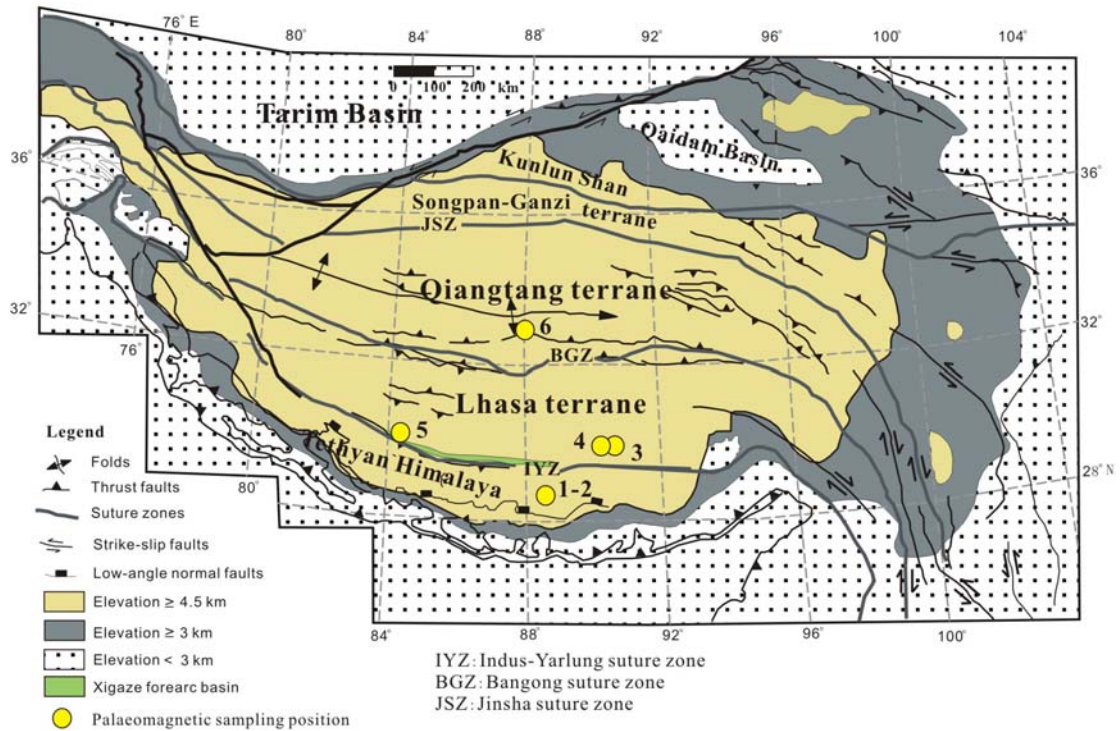
57

58



59

60 **Fig. S5** Equal-area projection showing palaeomagnetic poles of a  
 61 reference site comparison between northern margin of India and southern  
 62 margin of Asia. Numbers 1-6 correspond to palaeomagnetic poles  
 63 described by the authors as follows: 1, Patzelt *et al.* (1996)<sup>3</sup>; 2 and 3, Yi  
 64 *et al.* (2011)<sup>4</sup>; 4, Tan *et al.* (2010)<sup>5</sup>; 5, Sun *et al.* (2012)<sup>6</sup> and van  
 65 Hinsbergen *et al.* (2012)<sup>7</sup>; 6, This study. The black line stands for the  
 66 palaeolatitude obtained from the upper Cuojiangding Group. Confidence  
 67 limits which were calculated according Coe *et al.* (1985)<sup>8</sup> are illustrated  
 68 as black dashed lines. The data are plotted in the Northern Hemisphere.  
 69 All the selected results from Asia are indistinguishable within the error,  
 70 indicating a constant palaeolatitude for the southern margin of Asia from  
 71 the Cretaceous to Palaeogene time.



72

73 **Fig. S6** Tectonic and topographic map of the Tibetan-Himalaya to show  
 74 the sampling locations of palaeomagnetic studies we used for this study  
 75 (Modified after DeCelles *et al.* 2007<sup>9</sup>). Numbers 1-6 correspond to  
 76 palaeomagnetic studies as follows: 1, Patzelt *et al.* (1996)<sup>3</sup>; 2, Yi *et al.*  
 77 (2011)<sup>4</sup>; 3, Tan *et al.* (2010)<sup>5</sup>; 4, Sun *et al.* (2012)<sup>6</sup> and van Hinsbergen *et*  
 78 *al.* (2012)<sup>7</sup>; 5, This study; 6 Lippert *et al.* (2011)<sup>10</sup>.

79

80

81

82

83

84 **Supplementary Tables**

85 **Table S1:** Sample characteristic remanent directions (ChRMs) for the  
 86 upper Cuojiangding Group

Site ID	Strike	Dip	Direction fit code	Demagnetization steps	N	Dg	Ig	Ds	Is	$\alpha_{95s}$	Grade	Used or not
<b>Quxia Formation</b>												
mj001	65	84	Dir PCA	T330-T450	4	139.2	64.3	147.9	-18.7	13.7	C	no
mj002	65	84	DirOPCA	T330-T590	10	197.3	37.2	194	-31.5	6.8	A	yes
mj004	65	84	Dir PCA	T330-T450	4	176.1	69	162.6	-13.6	8.9	B	yes
mj005	65	84	Dir PCA	T360-T530	5	95.4	80.9	147.2	-1.4	6.8	B	yes
mj006	65	84	DirOPCA	T360-T500	4	171	61.8	163	-21.1	8.2	B	yes
mj007a	65	84	Dir PCA	T360-T450	3	221.4	30.6	210.5	-16.9	13.1	C	no
mj008a	65	84	Dir PCA	T250-T450	6	77.5	72.4	137.8	-2	9	C	no
mj017	90	65	DirOPCA	T450-T670	12	174.9	18.7	173.1	-46	6.4	A	yes
mj018	90	65	Dir PCA	T330-T530	6	126.2	35.4	137.9	-11.1	10.7	B	yes
mj019B	90	65	DirOPCA	T330-T580	9	145.7	29.1	146.6	-26.7	15.2	A	yes
mj020	90	65	DirOPCA	T450-T580	6	200.7	-13.4	243.2	-67.3	7.3	A	yes



---

mj021	90	65	Dir PCA	T360-T590	9	186.9	47.4	184.9	-17.3	7.6	A	yes
mj023-1	90	65	DirOPCA	T450-T580	6	164.3	22.3	160.9	-40.3	14.2	B	yes
mj023	90	65	DirOPCA	M030-M070	5	177.7	18.2	176.9	-46.7	4.1	A	yes
mj025	90	65	Dir PCA	T570-T590	3	156.1	39.6	160.4	-21.6	2.2	A	yes
mj026	90	65	Dir PCA	T330-T450	4	181.1	26.9	181.2	-38	18.9	C	no
mj036	90	65	DirOPCA	T640-T690	4	145.2	31.6	147.8	-24.3	4.1	B	yes
mj038	90	65	Dir PCA	T390-T590	8	149.3	6.5	132.4	-46.6	7.3	A	yes
mj039	90	65	DirOPCA	T420-T590	15	147.5	12.4	136	-40.9	9.3	B	yes
mj040	90	65	Dir PCA	T480-T530	4	171.1	2.7	161.5	-61	12.8	B	yes
mj041	90	65	DirOPCA	T360-T590	9	174.9	36.6	175.4	-28.2	7.1	A	yes
mj042	90	65	Dir PCA	T420-T480	3	201.6	22.2	205.8	-38.3	12.2	B	yes

**Gyalaze Formation**

mj043	90	65	DirOPCA	T300-T600	20	152.3	4.3	133.6	-50.2	5.3	A	yes
mj044	90	65	DirOPCA	T390-T580	15	191	32.9	190.8	-31.2	12.7	A	yes
mj045	90	65	DirOPCA	T480-T590	13	194.1	-8.8	222.1	-68.9	7.3	A	yes
mj046	90	65	DirOPCA	T420-T600	16	166.5	-2.2	148	-63.8	9.4	A	yes

---

---

mj047	90	65	Dir PCA	T330-T450	5	179.7	51.8	179.8	-13.2	7.7	B	yes
mj048	90	65	DirOPCA	T570-T600	5	129.5	25.5	132.3	-19.8	13.9	C	no
mj049	90	65	DirOPCA	T530-T570	7	190.9	33.8	190.5	-30.3	8.9	A	yes
mj050	90	65	DirOPCA	T250-T640	15	2.4	10.5	9.3	75.3	11.8	C	no
mj051	90	65	DirOPCA	T300-T550	12	183.3	-25.5	280.7	-87	6.2	B	yes
mj052	90	65	Dir PCA	T540-T560	3	60.7	-26.4	53	12.1	1.6	C	no
mj053	90	65	Dir PCA	T520-T575	9	147.1	10.1	133.6	-42.5	7.2	B	yes
mj054	90	65	DirOPCA	T300-T565	15	150.4	33.4	152.9	-25.1	9.6	A	yes
mj055-1	94	74	DirOPCA	M020-M060	5	179.3	36.5	179.3	-37.3	2.9	A	yes
mj055	94	74	DirOPCA	T500-T570	4	173.6	4.4	156.3	-67.1	11.4	A	yes
mj056	94	74	DirOPCA	T480-T580	10	171	4.1	150.4	-66.1	6.9	A	yes
mj057	94	74	DirOPCA	T480-T565	9	203.6	49.4	197.7	-22.3	2.6	A	yes
mj058	94	74	Dir PCA	T510-T530	3	197	8.2	212.9	-62.6	14.3	B	yes
mj059	94	74	Dir PCA	T450-T590	7	121.7	43	143.2	-7.9	9.5	B	yes
mj060	94	74	Dir PCA	T480-T530	4	144	54.8	161.8	-11.5	14.1	C	no
mj061	94	74	DirOPCA	T420-T565	11	229.6	17.9	238.9	-33.7	7.2	B	yes

---

---

mj063	94	74	DirOPCA	T510-T570	10	163.6	60.5	173.9	-11.8	9.2	B	yes
mj065	94	74	DirOPCA	T520-T580	10	137.1	55.9	159.6	-8.1	6.3	A	yes
mj066	94	74	Dir PCA	T330-T480	6	148	47.7	159.3	-18.6	7.7	A	yes
mj067	92	74	Dir PCA	T250-T390	5	241.3	15.7	246.4	-23.4	11.8	C	no
mj068	92	74	DirOPCA	T510-T590	9	357	-7.9	349.8	65.6	1.6	A	no
mj070	92	74	GCnPCA	T080-T250	5	109.1	11.6	288.2	12.8	4.9	C	no
mj073	92	74	GCnPCA	T390-T450	3	235.3	72.4	196.1	5.1	2.3	C	no
mj075	92	74	DirOPCA	T450-T570	5	345.1	-28.9	341.9	42.2	11.5	B	no
mj077	92	74	DirOPCA	T330-T420	4	193.5	46.7	190.8	-26.4	14	C	no
mj078	92	74	DirOPCA	T250-T570	10	143	9.7	123	-43.6	10.4	B	yes
mj079	93	74	DirOPCA	T450-T590	11	204.5	29.5	207.6	-40	4.8	A	yes
mj080	93	74	DirOPCA	T330-T390	3	208.4	23	216.1	-43.7	10.4	B	yes
mj081	93	72	GCnPCA	T150-T300	4	101.8	18.2	293	2.4	3.9	C	no
mj082	93	72	GCnPCA	T200-T300	3	106.8	3.6	280.8	11.9	12.6	C	no
mj083	93	72	DirOPCA	T480-T570	8	191	9.4	199.8	-61.5	6.1	A	yes
mj084	93	72	DirOPCA	T360-T575	14	157.9	2.8	130.6	-57.7	14.1	B	yes

---

---

mj086	93	72	DirOPCA	T330-T535	10	107.3	60	153.6	-8.6	13.8	C	no
mj087	93	72	GChPCA	T120-T250	4	113.9	13.2	292.6	15.1	11	C	no
mj088	93	72	DirOPCA	T390-T600	14	205.2	16.6	216.6	-49.1	14.4	B	yes
mj089	93	72	Dir PCA	T480-T570	8	220.8	9.2	240.1	-43.8	8.8	B	yes
mj090	93	72	GChPCA	T100-T360	7	135.9	36.3	324.1	19.8	3.1	C	no
mj091	93	72	DirOPCA	T330-T530	9	326.2	-3.6	300.1	47.8	5.8	B	no
mj097	93	72	DirOPCA	T420-T510	4	115.4	32.3	130.9	-8.1	5.5	C	no
mj098	93	72	Dir PCA	T360-T450	4	151	12	134.3	-46.4	11.7	B	yes
mj099	93	72	Dir PCA	T330-T420	4	178.9	65.2	181.3	-6.8	10.4	C	no
mj100	93	72	DirOPCA	T360-T450	4	174.8	40.8	175.8	-30.7	10.7	A	yes
mj102	93	72	DirOPCA	T360-T450	4	162.1	21.4	154.7	-45.6	11.4	B	yes
mj103	93	72	Dir PCA	T360-T420	3	158.8	58.2	170.3	-11.2	12.2	B	yes
mj105	93	72	GChPCA	T120-T250	4	150.7	48.5	341.2	17.5	1.2	C	no
mj106	93	72	Dir PCA	T360-T420	3	168.3	67.8	177.5	-3.5	21.5	C	no
mj107	93	72	DirOPCA	T450-T550	6	181.4	14	180.1	-58	13.9	B	yes
mj108	93	72	DirOPCA	T330-T510	7	153.4	40.3	158.3	-25.6	8.6	B	yes

---

---

mj109	93	72	DirOPCA	T200-T300	3	150.1	49.8	161.6	-16.2	8.8	B	yes
mj110	93	72	GcNPCA	T200-T330	4	239	57.7	209.3	2.2	13	C	no
mj111	93	72	DirOPCA	T360-T510	6	183.7	75.9	183.2	-3.9	8.6	B	yes
mj112	93	68	GcNPCA	T560-T580	4	119.8	48.8	147	0.4	6.9	C	no
mj113	93	68	DirOPCA	T540-T590	7	4	-53.9	3.6	14.1	9.3	A	no
mj114	93	68	GcNPCA	T120-T250	4	91.1	13.2	104.6	6.6	4.2	C	no
mj117	93	68	DirOPCA	T560-T600	6	207.3	3.9	228.5	-54.8	0.8	A	yes
mj118	93	68	DirOPCA	T250-T565	14	191.3	-3.8	208	-70.2	7.6	B	yes
mj119	93	68	Dir PCA	T300-T450	6	157.1	-4.3	124.5	-59.3	12.3	B	yes
mj120	93	68	GcNPCA	T300-T360	3	174.8	74.5	180.8	6.6	7.4	C	no
mj122	93	68	DirOPCA	T570-T590	3	106.5	29.3	125	-0.3	1.7	C	no
mj125	93	68	GcNPCA	T200-T300	3	145	39.3	332.7	19.2	5.5	C	no
mj229	288	56	DirOPCA	T390-T600	14	110.3	-24.7	130	-11.7	3.4	A	yes
mj231	288	56	DirOPCA	T450-T600	8	120.9	-24.7	135.5	-3.8	1.4	A	yes
mj232	288	56	DirOPCA	T420-T600	13	99.5	-62.3	164.5	-33.5	0.7	A	yes
mj234	288	56	DirOPCA	T550-T590	6	15.6	69.9	17.2	14	7.9	B	no

---

---

mj237	288	56	DirOPCA	T420-T570	11	76.5	-49	145.8	-44.9	9.5	A	yes
mj239	333	43	DirOPCA	T360-T530	7	75.8	-51.7	187.4	-80.4	8.1	B	yes
mj240	333	43	DirOPCA	T360-T510	6	100.4	-47	167	-64.8	8.1	B	yes
mj241	333	43	GCnPCA	T150-T420	8	261.3	15.6	274.8	55.1	13.4	C	no
mj242	333	43	GCnPCA	T80-T330	7	123.9	31.2	111.7	5.4	14.3	C	no
mj243-1	333	43	GCnPCA	T150-T360	6	48.7	6.2	225.5	35.3	15.3	C	no
mj243	333	43	DirOPCA	M20-M70	6	298.6	30	331.7	44.4	13.8	B	no
mj244	333	43	GCnPCA	T150-T360	6	250.1	15	255.8	57.5	6.7	C	no
mj245b	333	43	DirOPCA	M020-M090	8	346.4	51.8	19.8	28.5	4.6	B	no
mj246	333	43	DirOPCA	T330-T480	6	113.9	-29.2	147.2	-47.1	7.9	B	yes
mj247-1	333	43	GCnPCA	T150-T330	5	68.6	10.2	249.5	32.6	6.4	C	no
mj247	333	43	DirOPCA	M20-M90	8	333.6	36.9	0.5	25.7	5.3	C	no

---

87 Note: DirOPCA: best-fitting demagnetization trajectory (forced to the origin); DirPCA:  
88 best-fitting demagnetization trajectory; GCnPCA: great-circle fit; N: number of demagnetization  
89 steps used to define the ChRM;  $D_g$ ,  $I_g$ : Declination and Inclination in geographic coordinates  
90 (before tilt correction);  $D_s$ ,  $I_s$ : Declination and Inclination in stratigraphic coordinates (after tilt  
91 correction);  $\alpha_{95_s}$ : 95% limits confidence in stratigraphic coordinates; Grades *A*, *B* and *C* to the  
92 Zijdeveld diagram best-fits: *A* for very good to excellent, *B* for OK and seems right but doubtful  
93 and *C* for doubtful.

94

95 **Table S2:** Fold test results on ChRM with the summation of cosine  
 96 (SCOS) value for the structural correction using definition 2 of SCOS

The upper Cuojiangding Group (84.3°E, 29.9°N) N = 69 sites	
	SCOS values
In Situ	22.043
Unfolded	0.178
*95%	9.662
**99%	13.662

97 \*(\*\*): 95%(99%) critical values which must be exceeded for significant correlation.

98

99

100

101

102

103

104

105

106

107 **Table S3:** Summary of the Late Cretaceous-Eocene palaeomagnetic  
 108 results from northern India

Location (°N/°E)	Lithology	Age	n	D <sub>s</sub> (°)	I <sub>s</sub> (°)	$\alpha_{95s}$ (°)	Palaeolat.	VGP Lat.(°)	VGP Long.(°)	Field test	Reference
29/87	Zongpu Fm. sediments	57 Ma	4	154.0	-5.1	8.4	-2.5±5.3	49.8	309.7	F+	Besse <i>et al.</i> (1984) <sup>11</sup>
28.7/86.8	Zongpu Fm. sediments	62-66 Ma	3	162.4	-29.1	6.6	-15.6± 4.0	69.1	312.6	—	Tong <i>et al.</i> (2008) <sup>12</sup>
28.3/88.5	Zhongshan Fm. sediments	65-71 Ma	14	4.0	-11.2	8.5	-4.7±4.4	55.8	261.4	F+	Patzelt <i>et al.</i> (1996) <sup>3</sup>
28.3/88.5	Jidula Fm. sediments	63-66 Ma	4	178.6	-14.4	7.3	8.3±5.7	69.0	272.4	F+	Patzelt <i>et al.</i> (1996) <sup>3</sup>
28.3/88.5	Zongpu Fm. sediments	59-63 Ma	14	176.2	-7.9	7.5	5.0±5.9	65.4	277.6	F+	Patzelt <i>et al.</i> (1996) <sup>3</sup>
28.3/88.5	Zongpu Fm. sediments	59-62 Ma	18	180.8	-11.1	4.2	6.6±3.5	67.3	266.3	F+, R+	Yi <i>et al.</i> (2011) <sup>4</sup>
28.3/88.5	Zongpu Fm. sediments	56-59 Ma	14	177.0	-19.6	3.5	11.1±2.5	71.6	277.8	F+, R+	Yi <i>et al.</i> (2011) <sup>4</sup>

109 Note: n, number of sites; D<sub>s</sub>, declination (stratigraphic coordinate); I<sub>s</sub>, inclination (stratigraphic  
 110 coordinate);  $\alpha_{95}$ , 95% confidence limit (for stratigraphic data); Palaeolat., palaeolatitude for a  
 111 reference position; VGP, virtual geomagnetic pole; lat., latitude; long., longitude; Field test, F+,  
 112 positive fold test, R+, positive reverse test, — no information; Fm., Formation;

113



114 **Table S4:** Summary of the Late Cretaceous-Eocene palaeomagnetic  
 115 results from southern Tibet

Location (°N/°E)	Lithology	Age	n	D <sub>s</sub> (°)	I <sub>s</sub> (°)	$\alpha_{95s}$ (°)	Palaeo- lat.	VGP Lat.(°)	VGP Long.(°)	Field test	Reference
Late Cretaceous Data											
29.4/91.09	Takena Fm. sediments	K <sub>2</sub>	7	338.0	36.0	10.0	20.0± 7.8	68.0	340.0	F+	Pozzi and Westphal (1982) <sup>13</sup>
32.0/91.5 North	Takena Fm. sediments	100-125 Ma	6	338.7	25.4	8.9	13.3± 5.0	63.5	325.4	F+	Achache <i>et al.</i> (1984) <sup>14</sup>
29.9/91.0 South	Takena Fm. sediments	100-125 Ma	8	354.3	22.6	8.3	11.8± 6.2	71.2	288.4	F+	Achache <i>et al.</i> (1984) <sup>14</sup>
29.9/91.2	Takena Fm. sediments	K <sub>2</sub>	8	357.0	15.0	6.7	7.6± 3.5	68.0	279.0	F+	Lin and Watts (1988) <sup>15</sup>
29.9/91.2	Shexing Fm. sediments	65-110 Ma	43	350.2	42.0	2.5	24.2± 1.4	79.6	329.9	F+	Tan <i>et al.</i> (2010) <sup>5</sup>
29.9/91.2	Shexing Fm. Intercalated Volcanics	85-110 Ma	21	22.6	41.9	4.4	24.2± 3.3	69.1	191.7	F+	Tan <i>et al.</i> (2010) <sup>5</sup>
29.9/90.7	Shexing Fm. sediments	72-110 Ma	17	344.1	34.5	5.2	19.0± 5.3	71.9	327.2	F+	Sun <i>et al.</i> (2012) <sup>6</sup>
29.9/90.7	Shexing Fm. sediments	72-110 Ma	15	343.4	41.6	2.8	23.8± 2.3	74.1	342.7	F+	van Hinsberg- en <i>et al.</i> (2012) <sup>7</sup>
Palaeogene Data											
29.9/90.0	Linzizong Gp. Volcanics	48.5 Ma	2	0.0	18.0	—	8.3	69.3	271.0	—	Westphal and Pozzi (1983) <sup>16</sup>

29.9/90.0	Linzizong Gp. Volcanics	45-60 Ma	8	170.9	-25.5	11.0	13.5± 6.5	71.5	300.0	—	Achache <i>et al.</i> (1984) <sup>14</sup>
29.9/91.2 29.8/89.2	Linzizong Gp. Volcanics+Sediments	60-64 Ma	15	173.5	-14.8	8.8	6.6± 8.5	66	284.9	F+	Chen <i>et al.</i> (2010) <sup>17</sup>
30.0/91.2 29.8/89.2	Linzizong Gp. Volcanics+Sediments	44-60 Ma	23	355.9	20.0	6.9	10.8± 5.3	70.6	281.0	F+	Chen <i>et al.</i> (2010) <sup>17</sup>
30.0/91.1	Linzizong Gp. Volcanics	47-54 Ma	24	12.5	39.4	5.6	22.3± 5.0	76.9	205.8	—	Dupont- Nivet <i>et al.</i> (2010) <sup>18</sup>
29.9/90.0 30.0/91.1 29.9/91.2	Linzizong Gp. Volcanics	40-60 Ma	37	7.7	40.3	5.6	23.0± 4.2	80.8	217.3	F+	Dupont- Nivet <i>et al.</i> (2010) <sup>*18</sup>
29.9/91.1	Linzizong Gp. Dykes Volcanics	53 Ma	10	15.4	27.2	9.7	14.4± 5.8	68.9	225.4	F+, R+	Liebke <i>et al.</i> (2010) <sup>19</sup>
30.1/90.9	Linzizong Gp. Volcanics	55 Ma	14	359.0	21.6	9.2	13.6± 5.4	73.6	274.3	F+	Sun <i>et al.</i> (2010) <sup>20</sup>
29.9/91.2	Linzizong Gp. Volcanics	40-43 Ma	10	359.5	51.8	5.6	32.4± 4.8	86.3	91.2	F+	Tan <i>et al.</i> (2010) <sup>5</sup>
—	Linzizong Gp. Volcanics	47-56 Ma	52	3.5	35.5	3.6	19.6± 3.9	80.1	248.6	F+, R+	van Hinsberg- en <i>et al.</i> (2012) <sup>7</sup>
29.9/84.3	Upper Cuojiangding Gp. Sediments	54-57 Ma	62	168.1	-42.0	7.1	24.2± 5.9	78.0	329.0	F+	This study
33/88	Volcanics	32-38 Ma	20	—	—	—	28.7	—	—	—	Lippert <i>et al.</i> (2011) <sup>10</sup>

116 Note: n, number of sites; D<sub>s</sub>, declination (stratigraphic coordinate); I<sub>s</sub>, inclination (stratigraphic  
117 coordinate);  $\alpha_{95}$ , 95% confidence limit (for stratigraphic data); Palaeolat., palaeolatitude for a  
118 reference position; VGP, virtual geomagnetic pole; lat., latitude; long., longitude; Field test, F+,  
119 positive fold test, R+, positive reverse test, — no information; Fm., Formation; Gp., Group;  
120 Dupont-Nivet *et al.* (2010)\*, combined data from Achache *et al.* (1984)<sup>14</sup>, Dupont-Nivet *et al.*  
121 (2010)<sup>18</sup> and Tan *et al.* (2010)<sup>5</sup>.

122

123

124

125

126

127

128

129

130

131

132

133

134 **Table S5:** Palaeomagnetic poles and palaeolatitudes for the margin of  
 135 Asia and India used in Figure 6a

Numbers In Figure 6	Location		Age	Pole	Pole	Palaeolatitude (°)	Reference
	Locality	°N/°E		Latitude (°N)	Longitude (°E)	At Reference Position (29.9°N, 84.3°E)	
Sothern Asian Margin							
1	Xigaze forearc basin	29.9/84.3	54-57 Ma	78.0	329.0	24.2±5.9	This study
2	Southern Qiangtang terrane	33/88	32-38 Ma	--	--	25.6±3.8	van Hinsbergen <i>et al.</i> (2012) <sup>7</sup>
3	Southern Lhasa terrane	29.9/91.2	65-110 Ma	79.6	329.9	25.2±1.4	Tan <i>et al.</i> (2010) <sup>5</sup>
4	Southern Lhasa terrane	29.9/90.7	72-110 Ma	74.1	342.7	25.6±2.3	van Hinsbergen <i>et al.</i> (2012) <sup>7</sup>
5	Southern Lhasa terrane	29.9/91.2	85-110 Ma	69.1	191.7	21.9±3.3	Tan <i>et al.</i> (2010) <sup>5</sup>
Northern Indian Margin							
6	Tethyan Himalaya	28.3/88.5	65-71 Ma	55.8	261.4	-4.3±4.4	Patzelt <i>et al.</i> (1996) <sup>3</sup>
7	Tethyan Himalaya	28.3/88.5	59-62 Ma	67.3	266.3	7.2±3.5	Yi <i>et al.</i> (2011) <sup>4</sup>
8	Tethyan Himalaya	28.3/88.5	56-59 Ma	71.6	277.8	11.9±2.5	Yi <i>et al.</i> (2011) <sup>4</sup>
Southern Margin of Eurasian from Apparent Polar Wander Path (APWP)							
9	Eurasian APWP	--	0 Ma	88.5	173.9	29.9±1.9	Torsvik <i>et al.</i> (2012) <sup>21</sup>
9	Eurasian APWP	--	10 Ma	86.7	150	31.2±1.8	Torsvik <i>et al.</i> (2012) <sup>21</sup>
9	Eurasian APWP	--	20 Ma	84.4	152.1	31.9±2.6	Torsvik <i>et al.</i> (2012) <sup>21</sup>
9	Eurasian APWP	--	30 Ma	83.1	146.5	32.9±2.6	Torsvik <i>et al.</i> (2012) <sup>21</sup>
9	Eurasian APWP	--	40 Ma	81.1	144.3	33.7±2.9	Torsvik <i>et al.</i> (2012) <sup>21</sup>

9	Eurasian APWP	--	50 Ma	78.9	164.7	31.1±2.8	Torsvik <i>et al.</i> (2012) <sup>21</sup>
9	Eurasian APWP	--	60 Ma	78.2	172.6	29.6±2.1	Torsvik <i>et al.</i> (2012) <sup>21</sup>
9	Eurasian APWP	--	70 Ma	79.2	175.7	29.1±2.5	Torsvik <i>et al.</i> (2012) <sup>21</sup>
9	Eurasian APWP	--	80 Ma	79.7	177.9	28.7±2.9	Torsvik <i>et al.</i> (2012) <sup>21</sup>
9	Eurasian APWP	--	90 Ma	80.4	167.2	30.6±2.5	Torsvik <i>et al.</i> (2012) <sup>21</sup>
9	Eurasian APWP	--	100 Ma	80.8	152.3	33.0±3.3	Torsvik <i>et al.</i> (2012) <sup>21</sup>
9	Eurasian APWP	--	110 Ma	81.2	193.1	26.7±3.3	Torsvik <i>et al.</i> (2012) <sup>21</sup>
Northern Margin of India from APWP							
10	Indian APWP	--	0 Ma	88.5	173.9	29.9±1.9	Torsvik <i>et al.</i> (2012) <sup>21</sup>
10	Indian APWP	--	10 Ma	87.2	240.4	27.3±1.8	Torsvik <i>et al.</i> (2012) <sup>21</sup>
10	Indian APWP	--	20 Ma	83.7	254.7	23.7±2.6	Torsvik <i>et al.</i> (2012) <sup>21</sup>
10	Indian APWP	--	30 Ma	79.7	281.7	20.0±2.6	Torsvik <i>et al.</i> (2012) <sup>21</sup>
10	Indian APWP	--	40 Ma	74.7	286.8	15.6±2.9	Torsvik <i>et al.</i> (2012) <sup>21</sup>
10	Indian APWP	--	50 Ma	65.1	278.4	5.6±2.8	Torsvik <i>et al.</i> (2012) <sup>21</sup>
10	Indian APWP	--	60 Ma	48.5	280.8	-10.2±2.1	Torsvik <i>et al.</i> (2012) <sup>21</sup>
10	Indian APWP	--	70 Ma	36.4	280.7	-21.9±2.5	Torsvik <i>et al.</i> (2012) <sup>21</sup>

136

137

138

139

140 **References for Supplementary Materials:**

- 141 S1 Day, R., Fuller, M. & Schmidt, V. Hysteresis properties of  
142 titanomagnetites: grain-size and compositional dependence. *Phys.*  
143 *Earth Planet In.* **13**, 260-267 (1977).
- 144 S2 Dunlop, D. J. Theory and application of the Day plot (Mrs/Ms  
145 versus Hcr/Hc) 1. Theoretical curves and tests using  
146 titanomagnetite data. *J. geophys. Res.* **107**, B32056 (2002).
- 147 S3 Patzelt, A., Li, H. M., Wang, J. D. & Appel, E. Palaeomagnetism  
148 of Cretaceous to Tertiary sediments from southern Tibet: Evidence  
149 for the extent of the northern margin of India prior to the collision  
150 with Eurasia. *Tectonophysics* **259**, 259-284 (1996).
- 151 S4 Yi, Z., Huang, B., Chen, J., Chen, L. & Wang, H. Palaeomagnetism  
152 of early Palaeogene marine sediments in southern Tibet, China:  
153 Implications to onset of the India-Asia collision and size of Greater  
154 India. *Earth Planet Sci. Lett.* **309**, 153-165 (2011).
- 155 S5 Tan, X. D. *et al.* New palaeomagnetic results from the Lhasa block:  
156 Revised estimation of latitudinal shortening across Tibet and  
157 implications for dating the India-Asia collision. *Earth Planet Sci.*  
158 *Lett.* **293**, 396-404 (2010).
- 159 S6 Sun, Z. *et al.* Palaeomagnetism of late Cretaceous sediments from  
160 southern Tibet: Evidence for the consistent palaeolatitudes of the

- 161 southern margin of Eurasia prior to the collision with India.  
162 *Gondwana Res.* **21**, 53-63 (2012).
- 163 S7 van Hinsbergen, D. J. J. *et al.* Greater India Basin hypothesis and a  
164 two-stage Cenozoic collision between India and Asia. *Proc. Natl*  
165 *Acad. Sci. USA* **109**, 7659-7664 (2012).
- 166 S8 Coe, R. S., Globerman, B. R., Plumley, P. W. & Thrupp, G.A.  
167 Palaeomagnetic results from Alaska and their tectonic implications.  
168 in *Tectonostratigraphic terranes of the Circum-Pacific region:*  
169 *American Association of Petroleum Geologists* (ed D.G.  
170 Howell) 85-108 (Circum-Pacific Council on Energy and  
171 Resources Earth Sciences Series, 1985).
- 172 S9 DeCelles, P. G., Kapp, P., Ding, L. & Gehrels, G. E. Late  
173 Cretaceous to middle Tertiary basin evolution in the central  
174 Tibetan Plateau: Changing environments in response to tectonic  
175 partitioning, aridification, and regional elevation gain. *Geol. Soc.*  
176 *Am. Bull.* **119**, 654-680 (2007).
- 177 S10 Lippert, P. C., Zhao, X., Coe, R. S. & Lo, C. H. Palaeomagnetism  
178 and  $^{40}\text{Ar}/^{39}\text{Ar}$  geochronology of upper Palaeogene volcanic rocks  
179 from Central Tibet: implications for the Central Asia inclination  
180 anomaly, the palaeolatitude of Tibet and post-50 Ma shortening  
181 within Asia. *Geophys J. Int.* **184**, 131-161 (2011).

- 182 S11 Besse, J., Courtillot, V., Pozzi, J., Westphal, M. & Zhou, Y.  
183 Palaeomagnetic estimates of crustal shortening in the Himalayan  
184 thrusts and Zangbo suture. *Nature* **311**, 621–626 (1984).
- 185 S12 Tong, Y. *et al.* Early Paleocene paleomagnetic results from  
186 southern Tibet, and tectonic implications. *Int. Geol. Rev.* **50**,  
187 546-562 (2008).
- 188 S13 Pozzi, J. P., Westphal, M., Zhou, Y. X., Xing, L. S. & Chen, X. Y.  
189 Position of the Lhasa block, South Tibet, during the late Cretaceous.  
190 *Nature* **297**, 319-321 (1982).
- 191 S14 Achache, J., Courtillot, V. & Xiu, Z. Y. Palaeogeographic and  
192 tectonic evolution of southern Tibet since middle Cretaceous time:  
193 New palaeomagnetic data and synthesis. *J. Geophys. Res.* **89**,  
194 10311-10339 (1984)
- 195 S15 Lin, J. L. & Watts, D. R. Palaeomagnetic results from the Tibetan  
196 Plateau. *Phil. Trans. R. Soc. A, Mathematical and Physical*  
197 *Sciences* **327**, 239-262 (1988).
- 198 S16 Westphal, M., Pozzi, J. P., Zhou, Y. X., Xing, L. S. & Chen, X. Y.  
199 Palaeomagnetic data about southern Tibet (Xizang)—The  
200 Cretaceous formations of the Lhasa block. *Geophysical Journal of*  
201 *the Royal Astronomical Society* **73**, 507-521 (1983).
- 202 S17 Chen, J. S., Huang, B. C. & Sun, L. S. New constraints to the onset  
203 of the India-Asia collision: Paleomagnetic reconnaissance on the



- 204 Linzizong Group in the Lhasa Block, China. *Tectonophysics* **489**,  
205 189-209 (2010).
- 206 S18 Dupont-Nivet, G., Lippert, P. C., van Hinsbergen, D. J. J., Meijers,  
207 M. J. M. & Kapp, P. Palaeolatitude and age of the Indo-Asia  
208 collision: palaeomagnetic constraints. *Geophys J. Int.* **182**,  
209 1189-1198 (2010).
- 210 S19 Liebke, U. *et al.* Position of the Lhasa terrane prior to India-Asia  
211 collision derived from palaeomagnetic inclinations of 53 Ma old  
212 dykes of the Linzhou Basin: constraints on the age of collision and  
213 post-collisional shortening within the Tibetan Plateau. *Geophys J.*  
214 *Int.* **182**, 1199-1215 (2010).
- 215 S20 Sun, Z. M., Jiang, W., Li, H. B., Pei, J. L. & Zhu, Z. M. New  
216 paleomagnetic results of Paleocene volcanic rocks from the Lhasa  
217 block: Tectonic implications for the collision of India and Asia.  
218 *Tectonophysics* **490**, 257-266 (2010).
- 219 S21 Torsvik, T. H. *et al.* Phanerozoic polar wander, palaeogeography  
220 and dynamics. *Earth-Sci. Rev.* **114**, 325–368 (2012).  
221  
222