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Paleomagnetic results of Core NP93-2 from the Prydz Bay, Eastern Antarctica

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Abstract Two reversal geomagnetic excursions are detected by systematically paleomagnetic measurements of the Core NP93-2 from the Prydz Bay, Eastern Antarctica. One is found in 60 to 67.5 cm from the top of the core, and the ^{14}C dating age of layer 67.5 cm to 72.5 cm is 10315±800 a B. P. It is estimated that the geomagnetic excursion occurred at 9980～8880 a B. P., and perhaps was the record of the Gothenburg geomagnetic excursion (about 12000 a B. P.). The other is found in 27.5～32.5 cm, and the ^{14}C dating age is 5390±600 a B. P., with which no generally acknowledged geomagnetic excursion can be compared. But a few reports of geomagnetic excursions can be used for comparing with, Zhu *et al.* reported a geomagnetic excursion at 4980～4770 a B. P. from peat in Beijing, Wang *et al.* reported a geomagnetic excursion at 5120±110 a B. P. from Core NS-89-76 in Nansha Waters and Zhou *et al.* reported a geomagnetic excursion at 6400～6000 a B. P. from Core QC2 in Yellow Sea. Whether the studied geomagnetic excursion does exist or whether those reported geomagnetic excursion are the same one is worth further study.
Key words paleomagnetic, geomagnetic excursion, Eastern Antarctica, Prydz Bay.

1 Lithologic description and sample collection

The Core NP93-2 (core length 86 cm) was collected from the Prydz Bay, Eastern Antarctica, which is located at 67°59′S and 73°08′E with water depth 550 m (Fig. 1). From the top of the core, downwards, the grain size shows an obvious tendency, from fine to corse and then to fine. The lithologic characters are described as below:

0～8.5 cm yellowish-brown clayey silt-fine sand, with black organic clay at the top 1 cm;

8.5～22.5 cm greyish-green clayey silt-fine sand;

22.5～37.0 cm greyish-green gravel-silty clay;

37.0～71.0 cm greyish-green clayey silt-fine sand containing gravel;

71.0～75.5 cm greyish-black silty clay;

75.5～86.0 cm greyish-black silty clay.

The core was collected by gravity piston sample collector with a plastic liner tube. It was splitted in laboratory, then the samples were continuously collected from the top of the core with 2. 5×2. 5 cm transparent non-magnetic cylinder plastic sample containers, and 34 paleomagnetic samples were obtained in total.

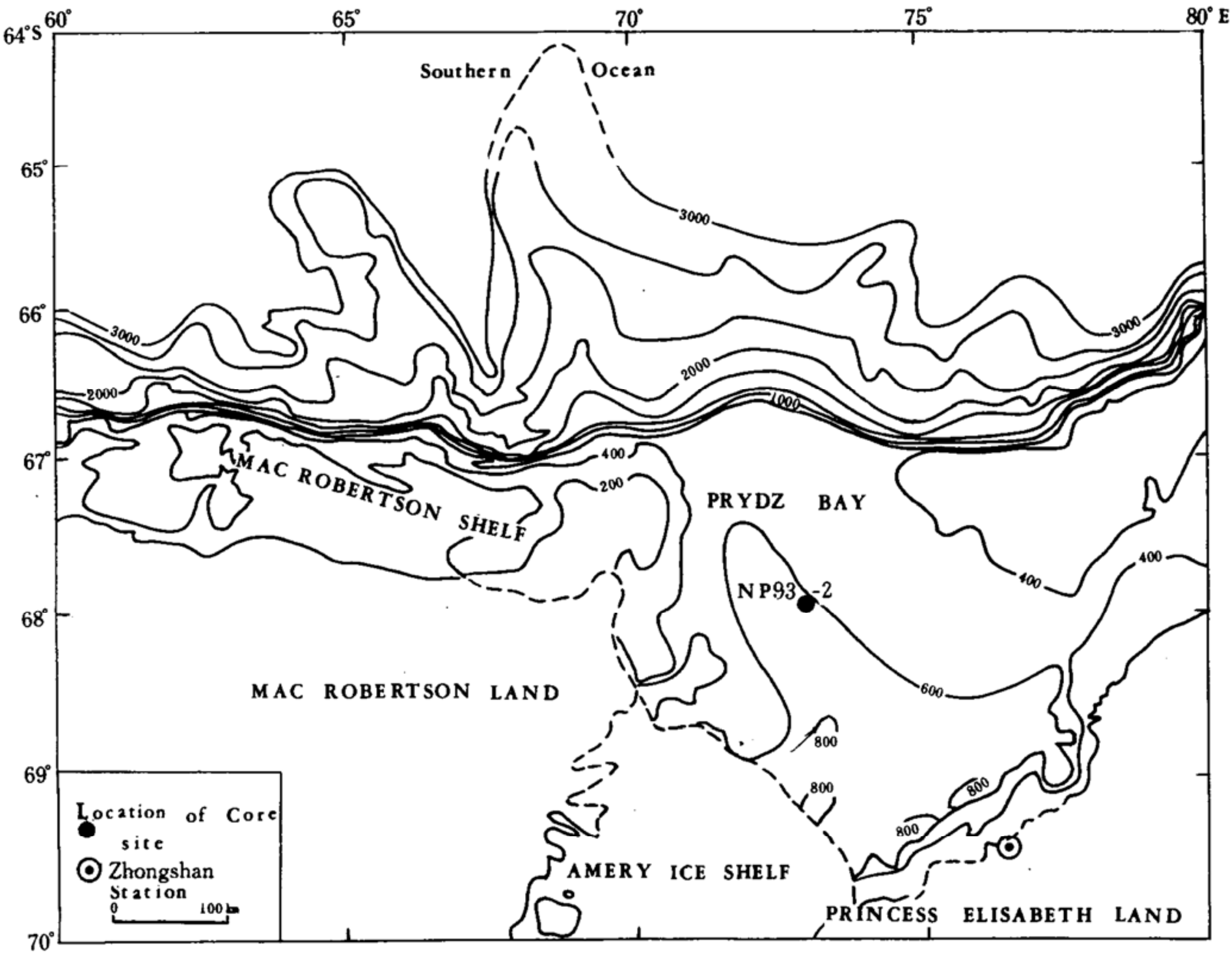


Fig. 1. Location of Core NP93-2.

2 Paleomagnetic measurement

Systematically demagnetization and paleomagnetic measurements have been carried out in Paleomagnetism Laboratory, South China Sea Institute of Oceanology, Academia Sinica. Magnetic measurements were performed with DSM-1 digital spinner magnetometer system, and demagnetizer was employed with GSD-1 alternative demagnetizer system which was improved with a three-axis spinner system instead of the old one-axial spinner system. In order to eliminate the secondary magnetization and obtain the primary magnetization , all samples have been demagnetized by a series of gradually increasing alternative magnetic field 2. 5, 5, 7. 5, 10, 15, 20, 15, 30, 35, 40,…,100 mT,and then the remanent magnetization is measured. Typical demagnetizion curves are shown in Fig. 2.

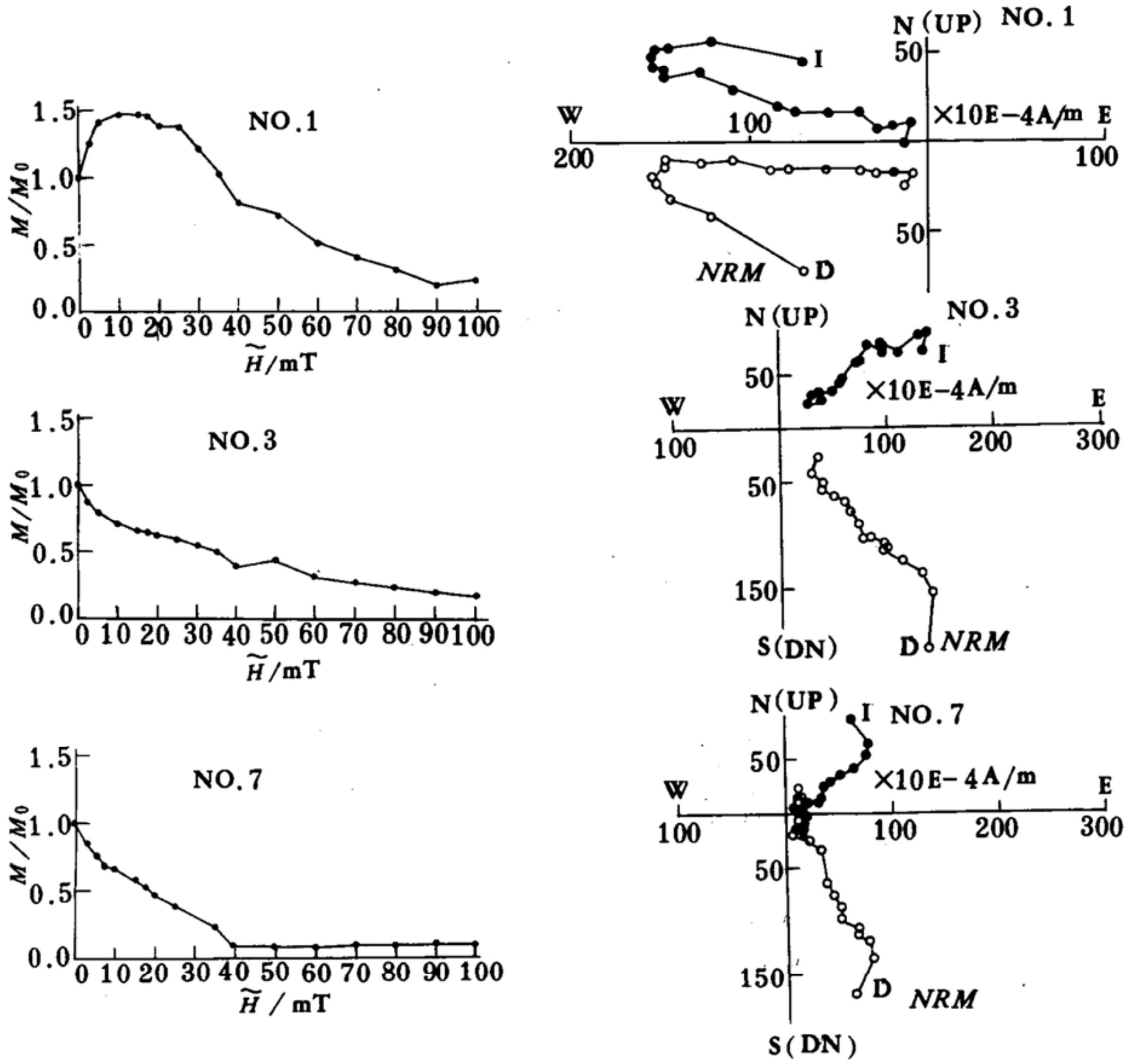
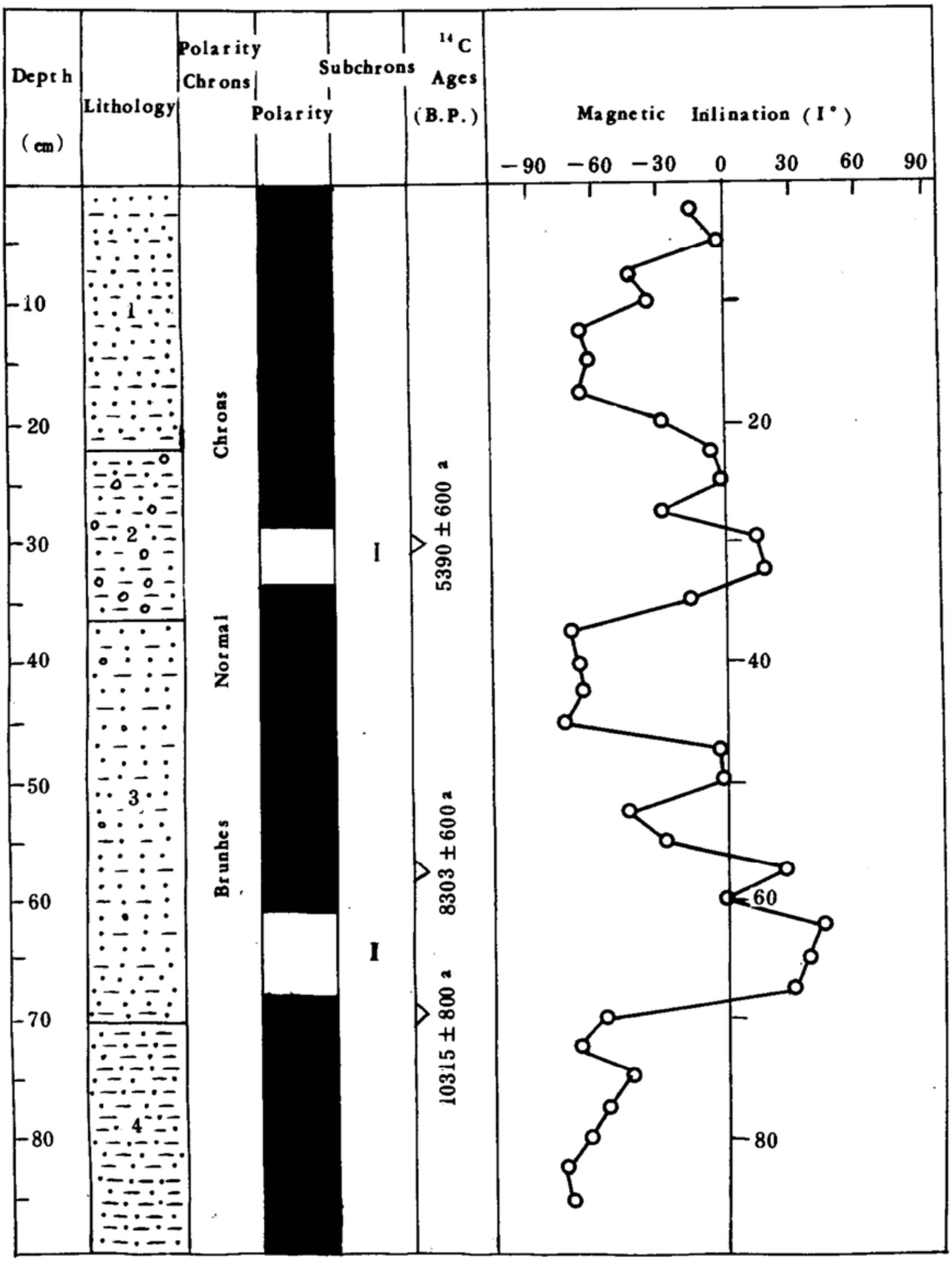


Fig. 2. Typical demagnetization curves of samples from Core NP93-2.

Systematically demagnetization of samples shows that remanent magnetization intensity of most samples change considerably when the alternative field ranges from 0 to 30 mT, then the remanent magnetization intensities decrease slowly and tend to stable ones. The directions of the remanent magnetization vary scatteredly to concentratedly when the alternative field ranges from 30 to 70 mT, which illustrates the remanent magnetization directions are stable and reliable. Therefore, it can be regarded as the characteristic remanent magnetization (ChRM). Principal component analysis method was adopted to seek the inclinations of ChRM, then the polarity variation is plotted against sample depth in Fig. 3.

From Fig. 3, 82% of samples are reversal polarity (corresponding to normal polarity in northern hemisphere), it indicates that the sediments of Core NP93-2 was deposited in Brunhes Normal Chron. However, two normal magnetized layers (corresponding to reversal magnetization in northern hemisphere) from 27.5 cm to 32.5 cm and 60.0 cm to



Legend
1. yellowish—brown clayey silt—fine sand
2. greyish—green silty clay containing gravel
3. greyish—green clayey silt—fine sand
4. greyish—black、greyish—green silty clay
I. non—denomination reversal polarity excursion
I. Gothenbury reversal polarity excursion
normal reversal

Fig. 3. Polarity variation curve of Core NP93-2.

67. 5 cm are detected. For distinguishing these reversal geomagnetic excursions, the authors named them Antarctic I and Antarctic II respectively. The Antarctic I reversal geomagnetic excursion is formed by two samples, with inclinations of 15. 0° and 18. 4° respectively, and the Antarctic II is formed by 3 reversal polarity samples , with inclinations of 41. 5°, 36. 3°, and 30. 6° respectively. From the view of magnetostratigraphy, these two reversal magnetized layers are both formed by several samples, and have obvious inclination difference from the neighboring samples(>45°). Hence, they represent two reversal geomagnetic excursions. So, these reversal magnetized layers possibly are the records of two geomagnetic excursions of the sediments from the Core NP93-2.

3 Paleomagnetic data interpretation and determination of geomagnetic excursions

As mentioned above, two reversal magnetized layers are detected with paleomagnetic measurements of Core NP93-2, whose ages are 5390±600 a B. P. and 10035±800 a B. P. , and which are temporarily called Antarctic I and Antarctic II reversal geomagnetic excursion respectively.

(1)Antarctic I reversal geomagnetic excursion. It is found in 27. 5 cm to 32. 5 cm from the top of the core , and ^{14}C dating age is 5390±600 a B. P. No definitely known reversal geomagnetic excursion can be compared with it in recent times. In China, a few reports about the reversal geomagnetic excursion occurring about 5000~6000 a B. P. are made in succession. For instance , in Beijing, a reversal geomagnetic excursion of about 5050~4780 a B. P. from peat was reported (Zhu *et al.* , 1993); in Yellow Sea, Zhou and Li (1989) reported a reversal geomagnetic excursion of about 6400~6000 a B. P. at layer 8. 2~8. 7 m from drilling Core QC2; in Nansha Waters, Wang *et al.* (1991) reported a reversal geomagnetic excursion with ^{14}C dating age of 5120±110 a B. P. at layer 42. 5~55. 0 cm from Core NS-89-76. Besides, there are other reports, for instance, Cong *et al.* (1980) reported a reversal magnetized layer at 9. 2~12. 3 m from drilling Core PY-19 and Ma *et al.* (1994) reported a reversal geomagnetic excursion at a depth of 5. 5 m from a lacustrine core in Gucheng of Jiangsu Province. Hence, it is speculated that these excursions occurred about 7000±8000 a B. P. and 7085~7005 a B. P. respectively. Whether these reported reversal geomagnetic excursions are the same one or whether this geomagnetic excursion existed really remains to be detailedly studied and confirmed.

(2)Antarctic II reversal geomagnetic excursion. It is found in layer 60~67. 5 cm from the top of the Core NP93-2, ^{14}C dating ages of sediments at layer 55~60 cm and 67 ~72. 5 cm are 8303±800 a B. P. and 10315±800 a B. P. respectively. By using interpolation method , the age of layer 60 cm to 67. 5 cm is 9430±550 a B. P. , and is well consistent with the division of biostratigraphy. Hence, it is reasonable to regard Antarctic II which was located in layer 60~67. 5 cm as the sediments record of Gothenburg reversal geomagnetic excursion in the research sea area (Mörner ,1977). This geomagnetic excursion was recorded universally in China: at layer 6. 45~7. 38 m from Tianyang drilling core with ^{14}C dating age of 12430±510 a B. P. (Chen, 1988); at layer 18. 86~19. 18 m from East China Sea drilling Core DC1 with ^{14}C dating age 11510±570 a B. P.

(Sun *et al.*, 1989); at layer 16. 8～18. 3 m from northern Jiangsu Province PY-19 with ^{14}C dating age of 11000～13000 a B. P. (Cong *et al.*, 1980); at 13. 5～14. 0 m from Yancheng drilling core with ^{14}C dating age 10800±140 a B. P. (Qian and Ma, 1979) and at layer 90～97. 5 cm from NS-89-76 in Nansha Waters with ^{14}C dating age of 12960±390 a B. P. (Wang *et al.*, 1991). Zhang (1983) also reported a record of Gothenburg reversal geomagnetic excursion from Pingliang profile, Shanxi Province, with its age about 10000 a B. P.; Zhu *et al.* (1992) reported a reversal geomagnetic excursion with ^{14}C age of 11060～10760 a B. P. from Qingfeng profile, Jianhu County, Jiangsu Province, Zhu *et al.* (1993) also reported another reversal geomagnetic excursion from peat in Fanshan area, Beijing, with ^{14}C dating age of 13700～14000 a B. P. and Ma *et al.* (1994) reported this reversal geomagnetic excursion from drilling cores from Gucheng Lake, Gaochun County, Jiangsu Province, with age of 9727～10307 a B. P.

As stated above, there is no doubt that the Gothenburg reversal geomagnetic excursion occurred about 12000 a B. P. from the Core NP93-2. Two reversal magnetized layers are measured in the depth of 60. 0～67. 5 cm and 27. 5～32. 5 cm, with ^{14}C ages 9430±550 a B. P. and 5390±600 a B. P. respectively. The first reversal geomagnetic excursion can be compared with Gothenburg geomagnetic excursion, and the second can be compared with the excursion of age 4980～4770 a B. P. reported from peat in Beijing, with the excursion of age 5120±110 a B. P. from NS-89-76 in Nansha Waters and with the excursion of age 6400～6000 a B. P. from drilling Core QC2 in Yellow Sea. To sum up, the authors draw the following conclusions: 1)Gothenburg reversal geomagnetic excursion occurred globally; 2) There was a geomagnetic excursion about 5000 a B. P. which was recorded as an abrupt change of geomagnetic field and lasted for a short time (about 1000 a). The discrepancy of reported ages was perhaps induced by dating methods.

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