8卷3期 沉 积 学 报 V.8, N 3
1990年9月 ACTA SEDIMENTOLOGICA SINICA Sept.1990

酒西盆地晚二叠世古地磁极及其大地构造意义

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提要 本文根据甘肃酒西盆地大黄沟剖面上二叠统"窑沟群"的古地磁资料确定了该盆地晚二叠世古地磁极位置及该区与华北地块的大地构造关系。剖面厚度约684米，共采集33层58个样品。对全部样品进行系统退磁处理后分离出了次生成因的低温分量和原生成因的高温分量。高温分量磁化方向经倾斜改正后密集度显著增强，平均磁化方向为−28.0°N/132.9°E（α95=4.7，K=47.1），相应的古地磁位于42.4°N/350.9°E（A95=3.9，K=67.8），均以99%以上的置信度通过了褶皱检验。由此可知，高温分量是在岩层发生褶皱之前获得的厚生剩磁，所代表的时限属基亚曼反向极性间隔。上述古地磁极位置与其他作者在山西、河北等地获得的结果极为相近，表明酒西盆地至少在晚二叠世就是华北地块的一部分 华北地块与塔里木地块在晚二叠世期间是两个独立的大地构造单元，古边界应位于酒西盆地以西，很可能是阿尔金断裂的前身或与之相当的断裂构造。

主题词 晚二叠世古地磁极 基亚曼反向极性间隔 华北地块与塔里木地块分离 阿尔金断裂

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THE LATE PERMIAN POLE OF THE WESTERN JIUQUAN BASIN (NW CHINA) AND ITS TECTONIC IMPLICATION

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Abstract

A mean direction of −28°N/132.9°E (α−95=4.7, k=47.1) and a corresponding pole at 42.4°N/350.9°E (α−95=3.9, K=67.8) were obtained from 21 out of 33 Upper Permian samples of continental sedimentary rocks collected from the Western Jiuquan Basin, over 1300km west to the places where previous paleomagnetic researches were con-

ducted for North China Block. The fair consistency of our results with the preexisting coeval ones demonstrates paleomagnetically that this area was a part of North China Block during Late Permian. If all the preexisting data from both North China and Tarim Blocks are assumed to be precise enough, then the ancient boundary between them should have been west to the Western Jiuquan Basin.The predecessor of Altyn fault or an analoque seems to be the first possible candidate to be chosen as this kind of ancient boundary.

Introdution

There have already existed various hypothesis concering the configuration between North China and Tarim Blocks and the tectonic relationship between these two Blocks and Siberian Block during the period of Late Permian.The prevailing opinion holds that these two Blocks had linked up along the Hexi Corridor in Late Paleozoic, formed the "Tarim–Sino–Korean Continent" (T. K. Huang*et al.*,1981), and accreted to Siberia (W. Y. Zhang *et al.*, 1982; Z.M.Zhang *et al.*, 1984; Z. Y. Yang*et al.*, 1986).Others argue that these two Blocks were seperated from each other and far away from Siberian Block as well even during Early Triassic (Klimeth,1983; Z.K Zhang, 1984). Some terrane people proposed the third idea that it was not until Late Triassic or later that the Northern Qilian (Nanshan) terrane, which is now situated between Tarim and North China Bolcks, immediately to the south of the area we studied, accreted to North China Block (X. Ji *et al.*, 1985).

Most paleomagnetic data obtained recently support the second hypothesis mentioned above for the period of Late Permian even Early Trassic (McElhinny *et al.*, 1981; W.Z.Lin *et al.*, 1984 Y.H.Bai *et al.*, *1985*; X.X.Zhao *et al.*, 1987) except that J.L. Lin et al. (1985) presented that North China, Tarim, and Siberian Blocks began to collide during Late Permian.

Hence, naturally comes the question that where the ancient boundary was if Tarim and North China Blocks were seperated then. According to traditional opinion, North China Block was bounded on the west by the western margin of Ordes Basin. Then, which Block suould have this vast area, which is now north to Qilianshan Mountain and situated between those two Blocks, belogned to or if it was an independent tectonic unit during that time?

In an attempt to discuss this question paleomagnetically, we made a field investigation in 1986 in the Western Jiuquan Basin located to the western end of the Hexi Corridor (a part of the ancient Silk Road) and the northern slope of Qilianshan Mountain. There we collected 58 oriented samples from 33 layers which are Late Permian in age. Our results coincied well with those obtained from other places on North China Blokc more than 1300km away. This consistency demonstrates that the area we studied was a part of North China Block during Late Permian. In orther words, North China Block extended westwerds to the western end of the present Hexi Corridor at least during Late Permian. Our results also support the hypothesis that North China Block did not amalgamate to Siberia during Later Permian. Moreover, our results indicate no significant internal relative movement took place during that time between this area and the other units belonging to North China Block where the previous paleomagnetic studies have been conducted.

General Geology

The Western Jiuquan Basin is a Ceno–Mesozic fault–bounded basin developed upon the folded Lower Paleozoic basement rocks which make up the principal part of North Qilian Caledonian folded belt running NWW–SEE. Two giant fault zones control the formation and evolution of this continental basin on both southern and northern sides, respectively. The southern one of them is known as Northern Margin Thrust of Qilianshan folded belt, and the northern one is the famous Altyn strike–slip fault. The basin is seperated on the east from the Eastern Jiuquan Basin by Wenshushan uplifted Block. The total area of the basin is about 2700 square kilometers.

The basin is almost thoroughly covered by unconsolidated Quarternary sediments of huge thickness (over 2500 m). Rocks outcrop well only arround the rim of the basin, especially along the southern margin of it. According to seismic and drilling data, the sedimentary cover rocks underneath the Quarternary are dominated by Ceno–Mesozic continental deposits; Paleozoic strata exist locally within some restricted places of the southern half of the basin. Continuous rock sequence occurs along the southern margin, including various rocks ranging from Cambrian to Neogene in age. Few Eogene (?) lava flows and dikes can be found in the western part of the basin on both southern and northern sides. All the strata stretch steadily over the whole area. Stratigraphic correlation can be easily made from here even to the eastern end of Qilianshan Mountain hundreds of kilometers away.

Sampling and Laboratory Techniques

The Upper Permian of the Western Jiuquan Basin is termed Yaogou Group. It is of continental origin in sedimentary facies. We colleted our samples from Dahuanggou Section, one of the rare type localities composed of Permian in NW China. The section is approximately 50 km southeast to the city of Yumen and 30km due south to the city of Jiayuguan, the western end of the Great Wall.

The total thickness of the Upper Permian we sampled is about 684m. The sequence is composed of colorred beds dominated by red and purple–red alternating sandstone and siltstone. Few small folds occur near the top of the section on the background that strata dip southeastwards regionally. We sampled from both limbs of the folds in an attempt to conduct a fold test for the directions of the magnetizations of the samples.

All the samples were collected with a portable gasoline powered drill. The samples were oriented in situ with an orienting stage and a Brunton compass. In addition to having recorded attitudes of the samples, we also measured solar azimuth angles with the .Brunton for most samples in all possible cases. When returned to the paleomagnetic laboratory of UCSC, we sliced the samples into cylindric specimens 2.5 cm in length. In most cases, more than one specimen could be obtained from each sample.

The data obtained from azimuth readings by computer proceeding were used to correct the original strikes for the corresponding samples. The two sets of readings showed no significant differences except 5–degree errors in few cases.

All the specimens to be measured were kept in the zero field room at UCSC for 2 to 3 weeks in order to remove their viscous magnetizations. Afterwards, the pilot specimens were subjected to either thermal or AF stepwise demagnetization. The interval for thermal cleaning was 50 degrees when in low temperature stage and 25, 20, 15, 10 or even 5 degrees when temperature was getting higher up to 700 ° or 715℃. The interval for AF demagnetization. was 25 or 50 Oe before 200 Oe and 200 Oe afterwards. A comparison of the results obtained with these two methods led us to give up AF method and conduct thermal demagnetizatin for most specimens left because this proceeding worked much more efficiently. We also tried a hybrid cleaning process on some specimens by making 3–step′s AF demagnetizing to 100 or 150 Oe, then continuing the demagnetizing with thermal method. We found that this kind of hybrid method seemed to work better than the single thermal one in most cases (Fig.1).

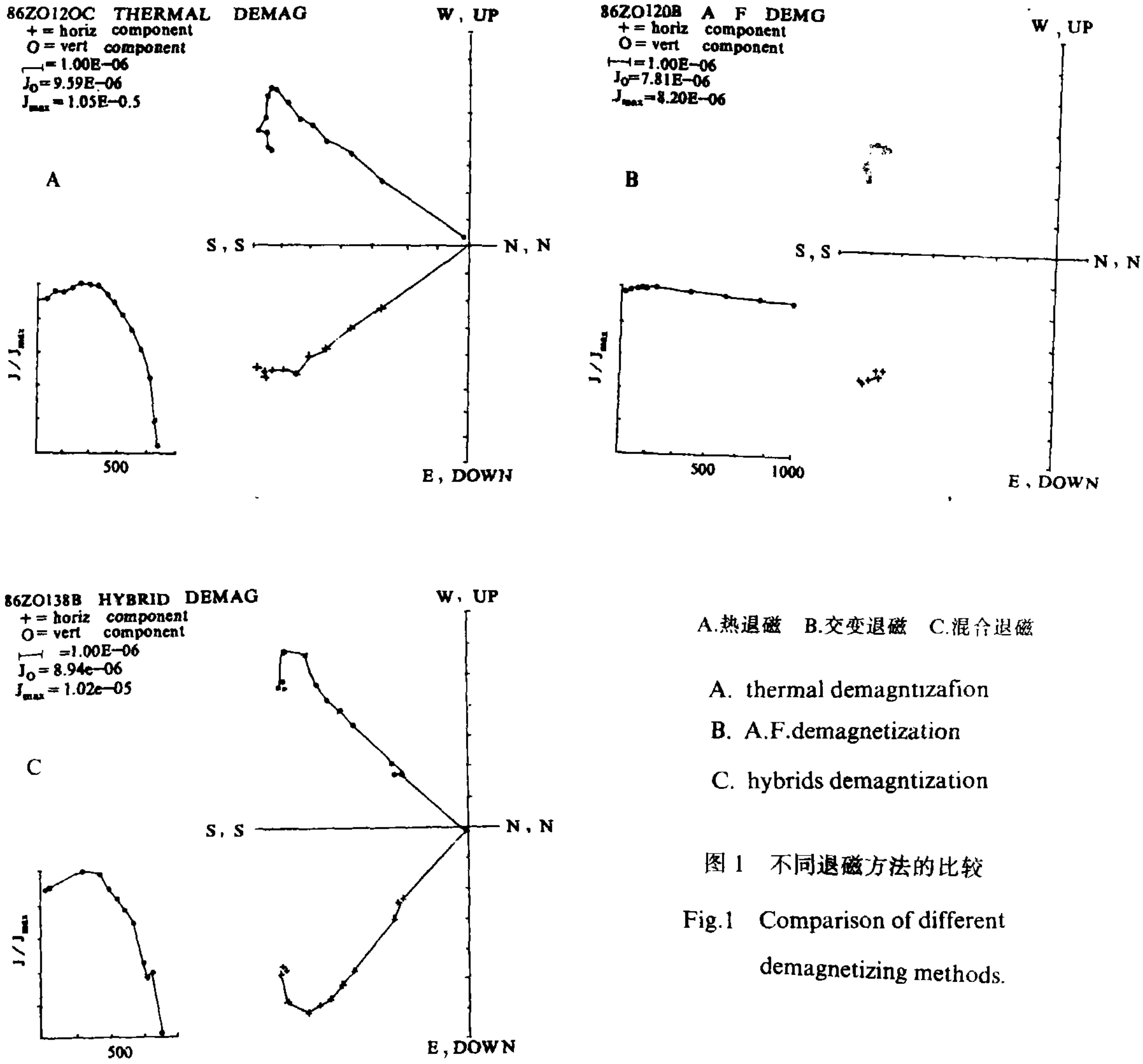
Results and Discussion

A common and obvious characteristic of the orthogonal vector diagrams indicates that almost each specimen has two different components: a low temperature one with a downward inclination and a high temperature one inclining upwards (Fig.2). The former has a direction close to the direction of the present earth′s field. The direction of the latter, however, is completely different from that of the present field of the earth.

The high temperature component was isolated when temperature arose to 350 degrees or so. Afterwards, almost all the specimens unexceptionally display stable endpoint decaying towards the origin. All the directions of these high temperature components cluster about a mean direction of −28 ° N / 132.9 ° E after tilt correction. The precise parameter increases more than 3 times than before the correction (Table 1, Fig.3), an indication that these directions passed a fold test at a level greater than 99 percent.

On the contrary, the low temperature components cluster arround the present earth′s field direction before tilt correction and scatter after it (Fig.4), suggesting that this kind of components is a secondary one acquired from subsequent normal overprinting.

All the evidences mentioned above enable us to firmly believe that this high temperature component is the primary component remaining within the samples, which had been obtained before the beds were folded. The fact that most samples possess primary magnetic components with a common southeastward direction and an upward inclination indicates that this kind of primary components was acquired during the period of Kiaman Reversal Interval.



A.热退磁 B.交变退磁 C.混合退磁

A. thermal demagntizafion

B. A.F.demagnetization

C. hybrids demagntization

图 1 不同退磁方法的比较

Fig.1 Comparison of different demagnetizing methods.

表 1 中国西北玉门上二叠统平均磁化方向

Table 1 Mean direction of the Upper Permian rocks from Yumen, NW China

Coordinate	α–95	k	Dec.	Inc.	Test.
Geographic	8.9	13.8	144.3	–22.0	
Stratigraphic	4.7	47.1	132.9	–28.0	F.

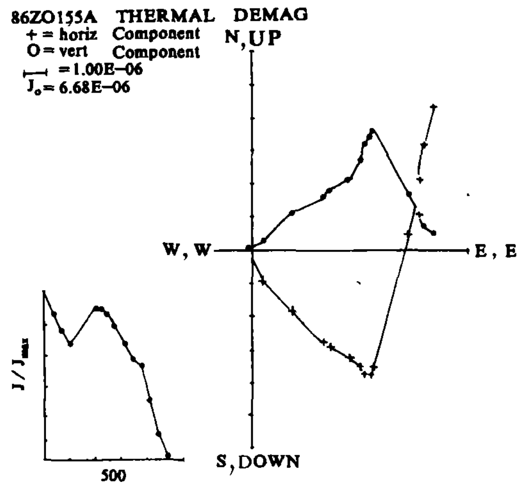


图 2　标本 No.155 的正交矢量图

Fig.2　Orthogonal vector diagram of the sample No. 155

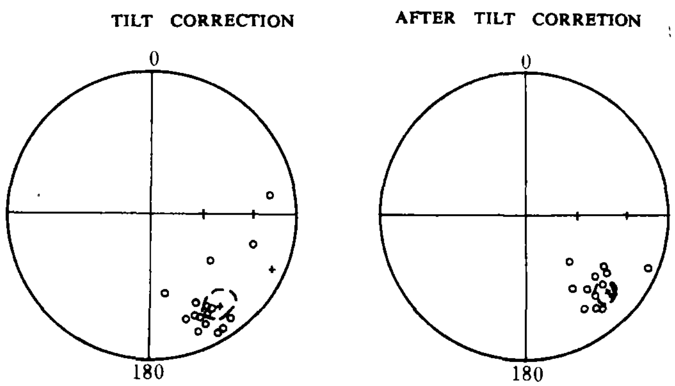
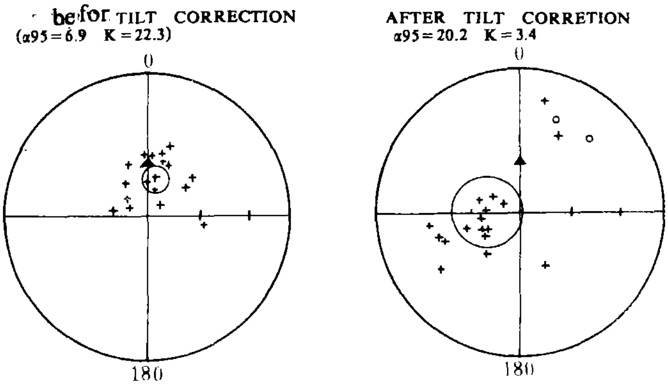


图 3　高温分量磁化方向

Fig.3　Directions of high temperature components

The Late Permian pole calculated from the mean direction of the primary components is located at 42.4 ° N / 350.9 ° E with an alpha−95 of 3.9, within 6 degrees of the poles for North China Block derived from other researches upon the coeval rocks in Shanxi and Hebei provinces (Tbale 2) . This consistency suggests that the area we studied was a part of North China Block at least during Late Permian. Therefore, it should have moved together with North China Block as a whole. No inference of significant relative rotation or translation between them during that time could be drawn paleomagnetically.

The remarkable difference between our Later Permian pole and those derived from Siberia and Europe is a meaningful aspect worth to study further because it implies that both northward translation and rotation took place between North China and these two blocks on a tremendous scale since Late Permian. This implication sharply contradicts the traditional view that North China Block was welded to Siberia by Late Permian.



▲现代地磁方向

图4 低温分量磁化方向

Fig.4 Directions of low temperature components

表2 华北地块晚二叠世古地磁极一览表

Table 2 Existing Late Permian poles for North China Block

Worker (s)	Locality	Pole Position	A-95	k
McElhinny et al. (1981)	37.8°N/112.4°E	44.0°N/358.8°E (N=12)	3.9	40.3
Z.K.Zhang (1984)	37 8°N/112.4°E	49.2°N/358.5°E (N=82)	2.0	17.4
W.Z.Lin et al. (1985)	37.9°N/113.8°E	56.7°N/006.2°E (N=8)	11.5	49.8
J.L.Lin et al (1985)	37.8°N/112.3°E	38.1°N/006.3°E (N=10)	?	?
X.X.Zhao et al. (1987)	38.6°N/112.1°E	46.2°N/005.2°E (N=11)	10.1	45 6
X.X.Zhao et al. (1987)	40.1°N/113.2°E	67.1°N/323.6°E (N=13)	14.0	20.6
X.X.Zhao et al. (1987)	37.5°N/114.4°E	54.3°N/004.1°E (N=17)	8.7	36.4
This Study (1987)	39.6°N/098.0°E	42.4°N/350.9°E (N=33)	3.9	67.8

Y.H.Bai *et al.* (1985) proposed paleomagnetically that Tarim and North China Blocks were two independent Blocks far away from each other by comparing the Early Permian pole for Tarim and the Late Permian Pole for North China Block, though these two poles are obviously not for the same time interval. They also suggested that Tarim Block had collided to Kazakhstan, Siberian, and Russian Blocks during the period from Late Carboniferous to Early Permian. If we assume all the preexisting paleomagnetic data stand reliable, then it can be easily deduced that the ancient boundary between Tarim and North China Blocks should have been located to the west of the Western Jiuquan Basin. Accordingly, the predecessor of Altyn Fault or an analoque seems to be the first possible candidate to be chosen. Undoubtedly, sufficient data from both sides of this fault and somewhere else are eagerly needed to decide this tectonically critical yet unsolved question definitively.

We would like to express our heartfelt thanks to Yumen Oil Administration in China for offering us conveniences in sample collection and to Dr. Zhao Xixi at UCSC for his efficient help in laboratory work.

收稿日期 1987 年 9 月 22 日

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