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Supplementary Material for:

North China Craton: the conjugate margin for northwestern Laurentia in Rodinia

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This file contains:

Supplementary text

Supplementary figures (Figure DR1, Figure DR2, Figure DR3 and Figure DR4)

Supplementary tables (Table DR1, DR2, DR3)

Supplementary references

SUPPLEMENTARY TEXT

S1. Laboratory conditions and procedures

A portable gasoline-powered drill was used to collect the paleomagnetic samples. The samples were then oriented with a magnetic compass, and a solar compass when possible. The difference between the results using the two orientation devices was less than 2º, suggesting no significant local declination anomalies. All the samples were cut into 1-3 standard cylinder paleomagnetic specimens in the laboratory.

All samples were subjected to stepwise thermal demagnetization using a TD-48 furnace (internal residual field less than 10 nT) in 10-70 ºC steps up to 580 ºC. Remanence was measured using an AGICO JR-6A spinner magnetometer and a 2G 755-4K superconducting magnetometer. The demagnetizations and measurements were performed in a shielded chamber with a residual field less than 300 nT. Rock magnetic studies were conducted on representative samples to identify the magnetic carriers. Temperature-dependent susceptibility was measured from –192 to 700 ºC (in argon) followed by cooling back to room temperature using a KLY-4S Kappabridge equipped with a CS-3 high temperature furnace apparatus and a CS-L low temperature cryostat apparatus. These experiments were all conducted at the Paleomagnetism and Environmental Magnetism Laboratory (PMEML) of the China University of Geosciences, Beijing (CUGB). A MicroMag Model 3900 Vibrating Sample Magnetometer (VSM) was used for Hysteresis loops and back-field demagnetizations of saturation isothermal remanent magnetization (IRM) at the Institute of Geophysics, China Earthquake Administration.

Vector components were isolated using principal component analysis (Kirschvink, 1980), and the mean directions were calculated using Fisher statistics (Fisher, 1953). Program packages developed by Enkin (1990) and Cogné (2003) were used to analyze the paleomagnetic data. The GPlates freeware package was used to carry out the paleogeographic reconstructions (Williams et al., 2012). The paleosecular variation was calculated using the method of Biggin et al. (2008), and the confidence interval (1σ) was calculated using the n–1 jackknife method (Efron, 1982).

S2. Rock magnetic results

The presence of the Hopkinson peak and Curie temperatures around 580 ºC of the thermomagnetic curves suggests that magnetite and/or low-Ti titanomagnetite are the main magnetic carriers in the specimens (Fig. DR1A, C), which is also supported by the Verwey transition (Verwey, 1939) at around –150 ºC (Fig. DR1A, C). Hysteresis loops of the specimens are “pot bellied” (Fig. DR1A) with saturation below 500 mT. Back-field demagnetizations of IRM show that the coercivities for most specimens are less than 30 mT (DR1B, D), implying a low-coercivity component, probably magnetite, as the dominant magnetic carrier in these specimens. On the Day diagram (Day et al., 1977; Dunlop, 2002), most hysteresis data fall in the PSD grain size area (Fig. DR1E) and some plot near the SD grain size area, indicating that PSD and SD grains dominate. In summary, the rock magnetic results demonstrate that the main magnetic carriers in these specimens are PSD and SD magnetite grains.

S3. Baked-contact test

We conducted two baked-contact tests for two dikes (LL13 and LL18). The two dikes are both about seven meters in width. The baked samples were derived from the baked host rocks at a distance of 10 to 50 cm from the contact. While the unbaked samples for dike LL13 were about 5 m from the contact and 400 m for dike LL18. After stepwise demagnetization up to 580 ºC, four samples from the baked gneisses of dike LL18 (Fig. DR2A, B) could isolate an HC which directs northeast with shallow inclination, which resembling that of dike LL18 (Fig. DR2C). Unfortunately, the samples from the unbaked gneisses display scattered demagnetization patterns. So the baked-contact test is inconclusive. And the samples from the host rocks of dike LL13 all show scattered demagnetization patterns.

S4. Paleogeography

In Figure 4C, D, The connections between Amazonia, Kalahari, Siberia and Laurentia are taken from Li et al. (2008) and Evans et al. (2016a); and the connections between Australia, Tarim and Laurentia were modified after Eyster et al. (2020) and Wen et al. (2018). The West Africa-Amazonia connection was taken from Bispo-Santos et al. (2014). In the ~930 Ma reconstruction, the position for Congo/SF is constrained by the ~920 Ma pole (BA) from Evans et al. (2016b). At ca. 780 Ma, India and South China Block (SCB) are placed around the polar region according to the pole (MAL) of the Malani large igneous province (Meert et al., 2013). The connection of India and South China were taken from Merdith et al. (2017).

SUPPLEMENTARY FIGURES

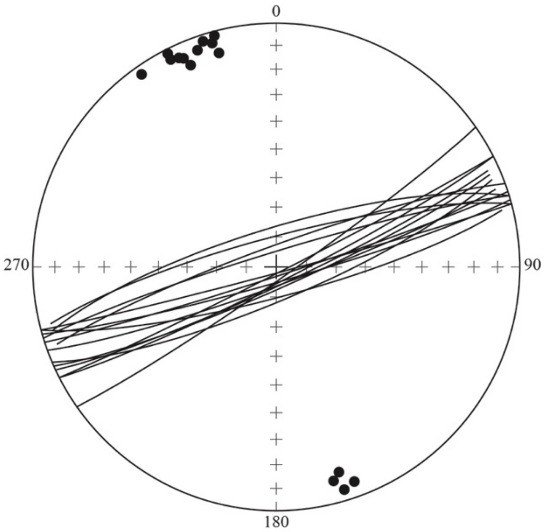

Figure DR1. Lower-hemsphere stereronet projections of the attitudes of dike orientation planes. The dots display the poles of dike orientation planes.

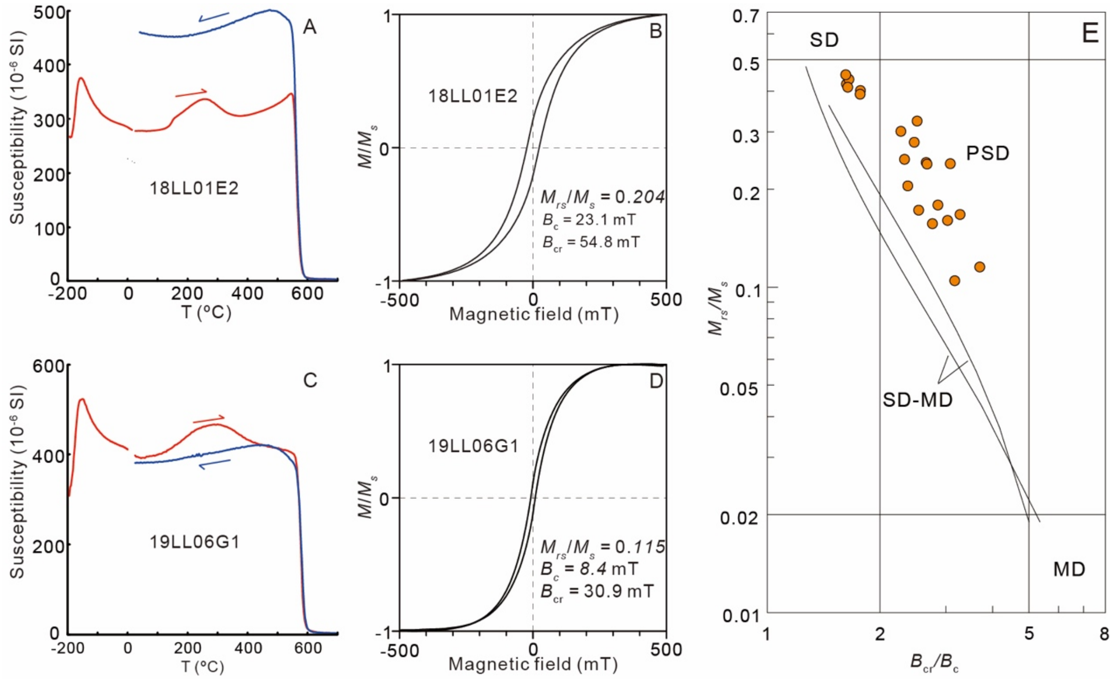

Figure DR2. Rock magnetic results for representative specimens of the ~775 Ma dikes. A, C: Low-field magnetic susceptibility versus temperature for heating (red line) and cooling (blue line). B, D: Magnetic hysteresis loops. E: Day plot (Day et al., 1977; Dunlop, 2002) of the hysteresis parameters. Ms, saturation magnetization; Mrs, saturation remanence; Bcr, coercivity of remanence; Bc, coercivity; SD, single-domain; PSD, pseudo-single domain; MD, multidomain.

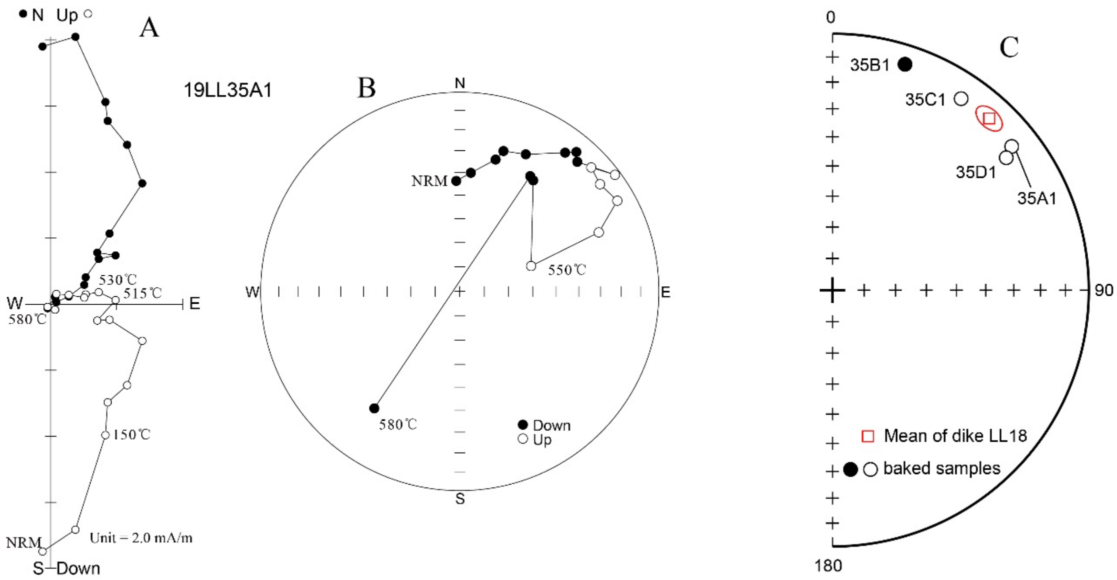

Figure DR3. Orthogonal demagnetization diagram (A) and equal-area projection (B) of the representative specimen from the baked gneisses in geographic coordinates. C: Equal-area projection of the HC directions of the baked gneisses and the mean HC direction of dike LL18.

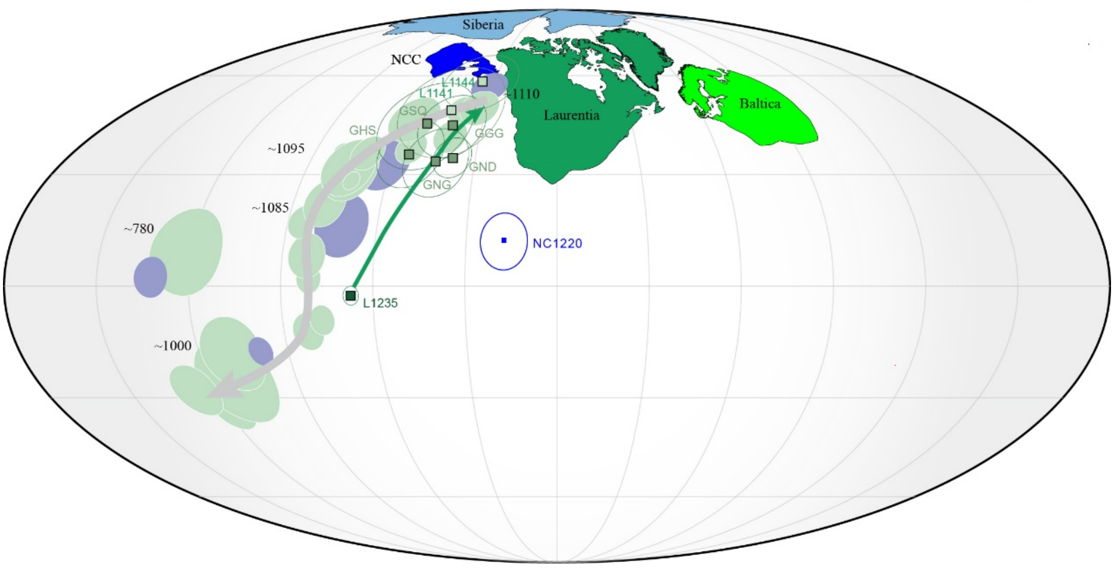

Figure DR4. Comparison of the ~1230-775 Ma poles of the North China Craton (NCC) and Laurentia (in present North American coordinates). The ~1230-1141 Ma poles are highlighted. The NCC and its poles are rotated to Laurentia using Euler rotation (58°, 30°, 68°). The poles are listed in Table DR2.

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