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The collision between Volgo-Sarmatia and Fennoscandia at ca. 1.76 Ga: new palaeomagnetic data from the Ukrainian Shield

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The East European Craton ("Baltica") was formed by the successive docking of the three crustal segments Fennoscandia, Volgo-Uralia and Sarmatia during the Palaeoproterozoic (Bogdanova et al., 2008). Volgo-Uralia and Sarmatia collided at 2.1-2.0 Ga to make up the Volgo-Sarmatia megacontinent, but as indicated by palaeomagnetic data (Elming et al., 2001; Pesonen et al., 2003) Fennoscandia was still a great distance away at that time. The final amalgamation of all segments to shape the East European Craton (EEC) only occurred between 1.82 and 1.75 Ga concomitantly with the aggregation of the Palaeoproterozoic Nuna/Columbia supercontinent (Hoffman, 1997; Rogers and Santosh, 2002). In what way that amalgamation took place is currently a matter of intense study. Quite obviously there exists a suture zone between these blocks that was subsequently followed by rifting and the formation of the Mesoproterozoic Volyn-Orsha and Middle Russian aulacogens, and thereafter burial beneath a Phanerozoic cover. Thus, palaeomagnetic approaches to assess the interrelationships of the EEC segments are of particular importance.

While the available data for Fennoscandia (Damm et al., 1997) and Volgo-Sarmatia (the "Ukraine" of Elming et al., 2001) appear to demonstrate that these continental blocks were still separated at 1.77-1.76 Ga, a problem of these reconstructions is that palaeomagnetic poles of Volgo-Sarmatia are close to the Devonian part of the APWP of Fennoscandia. Taking into account the strong rifting of Sarmatian crust in the Devonian, the remagnetizing influence of Devonian tectonothermal events cannot be excluded when reconstructing the palaeomagnetic pole of Volgo-Sarmatia at 1.77-1.76 Ga. For this study we sampled ca. 1.76 Ga rocks both from inside the Ukrainian Shield (the Ingul block, the Subbottsy-Moshorino zone) and in its NE margin against the Devonian Pripyat-Dniepr-Donets Aulacogen (near the Ovruch graben).

For the remanence measurements we used a 2G cryogenic magnetometer (Palaeomagnetic Laboratory, Lund University, Sweden) and JR-6 spinner magnetometer (Petromagnetic Laboratory, Moscow State University, Russia).

In the Subbottsy-Moshorino zone, ca. 1.76 Ga E-W-trending thin mafic dykes cut ca. 2.1 Ga granitoids. 23 samples were collected. In the mafic rocks, two components were recognized during stepwise thermal demagnetization. A low-temperature component that is present up to 380o C demonstrates high inclination with a mean direction close to the present-day magnetic field. A high-temperature component separated between 420 and 59o C has a mean direction of Dec=229.5 Inc=41.4 K=25.6 a95=6.1. Its paleomagnetic pole is Plat=-5.2 Plong=348.2 dp=7.3 dm=4.5. A component separated in the unbaked host granitoids (Dec=22.2 Inc=43.0) is similar to the high-temperature component of the Belokorovichi sediments (Elming et al. 2001). The mean direction of the high-temperature component in the mafic dykes is close to those obtained for granitoids and anorthosites from the Korosten pluton (Dec=217.3 Inc=19.1 K=22.0 a95=7.3; Elming et al., 2001), but with a slightly different inclination.

Near the Ovruch graben, a ca. 1.76 Ga mafic sill intruded 1.78 Ga granitoids of the Korosten Pluton. 22 samples of the mafic rocks were taken mostly from the contact zones but also from the central parts of the sill and from host granites. Conventional progressive thermal or alternating field demagnetizations were applied to all specimens. A high-temperature component was separated during stepwise thermal demagnetization. It mainly has single polarity and only in the contact-zone samples and host granites is there reversal. The mean direction is Dec=41.5 Inc=-31.8 K=51.4 a95=4.6. The paleomagnetic pole recalculated from this component is: Plat=-12.6 Plong =348.2 dp = 7.2 dm = 4.0. The high-temperature component from the host granites is Dec=38.7 Inc=17.1 K=277 a95=4.6.

This direction is close to those obtained for the Belokorovichi sediments (Elming et al. 2001).
The reversal pole plots in the Silurian-Devonian part of the Baltica's APWP (Smethurst et al., 1998). However, according to recent palaeomagnetic data this part of the APWP lies in shallow northern latitudes (Lubnina et al., 2007). This means that despite the sitting of the second locality near the Devonian aulacogen, Devonian tectonothermal events did not influence the primary magnetization.
Thus, if we accept the primary origin of the high-temperature components in the analyzed mafic rocks from both localities, Volgo-Sarmatia at ca. 1.76 Ga was located at 20-ties southern latitudes with an angular separation from Fennoscandia of about 50 degrees.

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