Identification of magnetic carriers of original and secondary NRM components recorded in Devonian sediments from Podolia, SW Ukraine

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Palaeozoic sediments are widespread in the west and southwest of the East-European platform. They are presented by carbonate-terrigenous rocks which thicknesses are increases westwards. The attention of geologists and paleontologists has been attracted for a long time to the Silurian — Lover Devonian sedimentary rocks because of quality of their exposure on the high and steep slopes of rivers and valleys, almost horizontal position, weak metamorphism and the abundance and breadth of fossils.

Most of paleomagnetic poles of Silurian and Devonian age published for the Russian Platform are coincident with the Late Palaeozoic part of the APWP. So, there is a suspicion that these poles are not well dated or are based on secondary magnetization. The Silurian-Devonian part of APWR is based mainly on extrapolation between best quality poles. Although apparently well defined, the Silurian-Devonian part lying close to the Carboniferous segment of the APWP needs verification by new reliable data, and the main problem is identification of magnetic carriers of NRN components recorded in Devonian red sediments.

New Paleomagnetic study of Devonian ferruginous sandstones and siltstones from Podolia revealed that the main direction was recorded during remagnetization in Permo — Carboniferous time. Thermal demagnetization of Natural Remanent Magnetization (NRM) showed that this component was carried by mineral with blocking temperature (T_b) about 600 °C. In several samples, at the end of demagnetization curves, besides this main component, we isolated Devonian direction with T_b close to the value of hematite (670—690 °C).

Thermomagnetic analysis giving decay curves of saturation remanence during heating SIRM(T) made for a whole rock gave T_b characteristic for hematite, but the presence of other minerals was not observed, especially mineral of $T_b \approx 600$ °C was not seen. Heating to 700 °C did not change composition of magnetic minerals. Thermomagnetic analysis made for the strongest component of NRM is similar to its thermal demagnetization — the main carrier of NRM is mineral with $T_b \approx 600$ °C. Intensity of NRM is about 1 % of SIRM intensity. It means that the main magnetic mineral observed on SIRM(T) curves — hematite — did not record any stable paleomagnetic direction. Comparison of hysteresis parameters of rock and AF demagnetization curves of NRM revealed that the magnetic grains which are the carriers of the main component of natural remanence are as hard as the grains of main mineral. Although their T_b is close to T_b of magnetite (≈600 °C) very high coercivity and remanence coercivity exclude magnetite or maghemite. The alternative is hematite with small content of titanium. Proper identification of this mineral has crucial significance for interpretation of NRM components. Regarding primary Devonian component found in some samples at the end of demagnetization curves we believe that it was recorded in small amount of hematite grains possibly of different origin then majority of hematite being the source of SIRM.

Petrologic studies based on scanning electron microscopy (SEM), wavelength dispersive spectroscopy (WDS) and X-ray diffraction (XRD) analysis revealed the presence of three main magnetic carriers:

1) detritic grains of hematite with small content of Ti — up to 3 % (size up to 100 μm),
2) authigenic, pure hematite crystals (1—2 μm size) occurring in the ferruginous cement of sandstones,

3) unidentified (Ti-hematite?) iron oxide, formed within the disintegrating detritic chlorite and biotite grains.

The detrital hematite (with small content of Ti) is a primary magnetic mineral contained inside the rock. This is a good candidate for being a carrier of the Devonian component of NRM. Unidentified iron oxides (Ti-hematite?) can be responsible for the Permo-Carboniferous remagnetization. Authigenic, pure hematite crystals (1—2 μm size) occurring in the ferruginous cement of sandstones are the main source of SIRM but majority of grains does not carry any stable component of NRM.