

The Remagnetization of Marine Carbonate Rocks of the Late Ordovician in Pingliang Section, Southwest Ordos (China)



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The natural remnant magnetization (NRM) of carbonate rocks in particular must be understood for the construction of a meaningful Paleozoic geomagnetic polarity time scale. This would enable evaluating geomagnetic features (e.g. reversal frequency) and would provide a paleomagnetic dating tool (Voo, 1990). The Ordos block, central China, was reported at low latitudes in the Southern Hemisphere during Ordovician times (Yang et al., 1999; Huang et al., 1999; 2000; Zhu et al., 1998). Ordovician strata, composed of carbonate and fine-grained clastic rocks, are well developed and exposed in Pingliang section of the SW Ordos (Finney, 1999). Motivated by Project IGCP 652, we collected three parallel oriented paleomagnetic samples at 21 sites in the Pingliang section (SW Ordos) in 2017. With a total thickness of 95 meters, this section covers the boundary of the Majiagou Formation and Pingliang Formation, with an early Sandbian age. The lithologies comprise mainly limestone (Fig. 1a), dolomite, siltstone, with several tuff layers intercalated. Most rocks are distinctly light brown, caused by weathering.

We cut the samples into 2 cm length cylindrical specimens in the laboratory. A set of specimens was stepwise thermally demagnetized up to 690°C or demagnetized with alternating field (AF) demagnetization up to 80 mT, and measured with a 2G Enterprises Model-760R superconducting rock magnetometer in a magnetically shielded room. We identify two NRM components (Fig. 1b); the first is a low-temperature component (~250°C), interpreted as a secondary NRM. The second is a middle-high temperature component (between 250°C and 500°C, sometimes up to 580°C), which carried by magnetite (mostly fine particles) and would be the characteristic remanent magnetization (ChRM). Its direction is declination at NW and inclination pointing down (Fig. 1b), with mean direction of $D_s=314.1^\circ$, $I_s=50.0^\circ$, $\alpha_{95}=7.2^\circ$.

Rock-magnetism measurements (including isothermal remanent magnetism (IRM), hysteresis loop and the first-order

inversion curve (FORCs)) have been carried out for four representative specimens. The results show that the isothermal remanent magnetization (IRM) of specimens are not saturated in fields 1000 mT with intermediate remanent magnetization coercivity (Bcr, Fig. 1c). This indicates that the magnetic minerals are intermediate coercivity minerals and low in content. In addition, the IRM is composed of two components, a soft component (with low $B_{1/2}$ of 22.9 mT) and a hard one (with high $B_{1/2}$ of 467.7 mT) (Fig. 1d). The hysteresis loops are wasp-waisted (Fig. 1e), suggesting mixing of soft and hard magnetic minerals. Finally, FORC diagrams of the sample show a more or less closed concentric contour maximum at ~20 mT (Fig. 1f), which would indicate a fair proportion of SD particles. In a Day plot, all samples plot between superparamagnetic envelope and the single domain-multidomain mixing line. Above all, we infer the NRM-carried minerals are mainly magnetite with some pyrrhotite.

The middle-high temperature component of NRM did not pass both the reversal and fold tests, indicating that the rocks are remagnetized (Voo, 1990; Liu et al., 2013; Huang et al., 2017). Using the ChRM to calculate the geomagnetic pole position yields $Plong=23.3^\circ$, $Plat=51.6^\circ$. In contrast with the Phanerozoic paleomagnetic pole position of North China block from previous studies (Huang et al., 2008), this pole position is very close to the pole of $Plong=353.1^\circ$, $Plat=50.1^\circ$ during the Middle Permian. We infer that the remagnetization might have occurred during the Permian as a result of block collision and tectonic activities (Zhao and Coe, 1987; Yang et al., 1998; Xiao et al., 2000; Li, 2017).

Key words: remagnetization, carbonate rocks, Ordovician, Southwest Ordos

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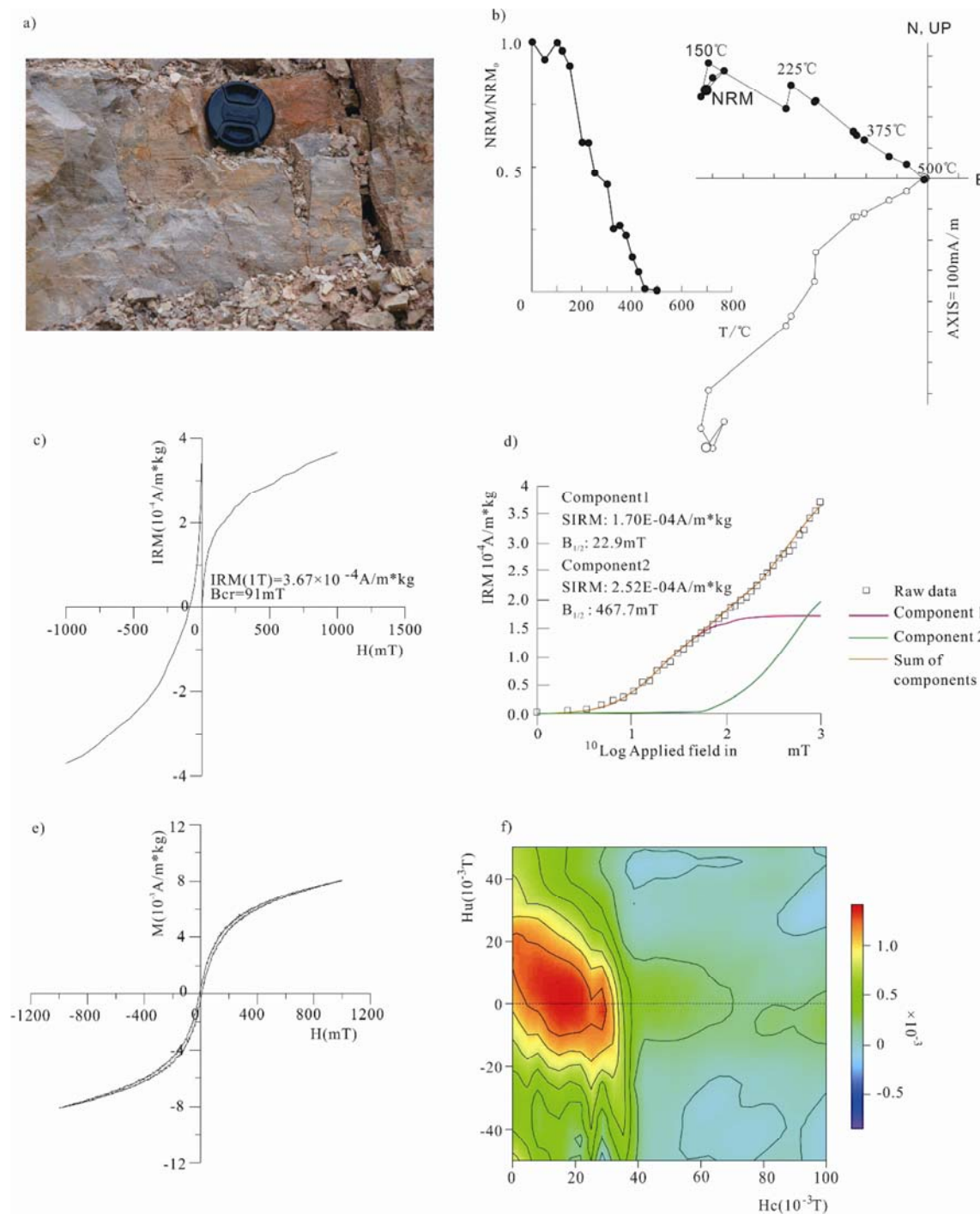


Fig. 1. Lithology, demagnetization behaviour and rock-magnetism experiments of the representative samples in Pingliang section.

a) The photography of limestone; b) Thermal demagnetization behaviour; c) Isothermal remanent magnetization (IRM) and back-field acquisition curves; d) IRM components fitting plot; e) Hysteresis loop; f) First-order reversal curve diagrams.

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