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Palaeomagnetism and geochronology of mafic dykes in south Siberia, Russia: the first precisely dated Early Permian palaeomagnetic pole from the Siberian craton

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SUMMARY

New palaeomagnetic and geochronological data from mafic dykes emplaced into the basement of the Siberian Craton on the southwestern coast of the Baikal Lake are present. The concordant zircon U–Pb SHRIMP age of these dykes is 275 ± 4 Ma. Palaeomagnetic study of the dykes isolated a stable primary remanence with steep upward direction supported by a positive baked contact test. The palaeomagnetic pole (50.5°N, 121.4°E, $A_{95} = 16.7°$) is the first precisely dated Siberian pole between ∼360 and 260 Ma. It falls near the interpolated Siberian APWP and suggests that Siberia had not joined Eurasia by 275 Ma. The studied dykes are the first reported evidence of Permian magmatic activity in the cratonic part of southern Siberia. They are probably related to the prominent 300–260 Ma magmatic event recognized in Trans-Baikalia. The comparison of our new result with recently published palaeomagnetic data from Trans-Baikalia suggests that differential movements between the Siberian Craton and blocks of Trans-Baikalia around 275 Ma are unlikely. This confirms tectonic models considering Trans-Baikalia as an Andean-type active margin of the Siberian continent in Permian times.

Key words: geochronology, mafic dykes, palaeomagnetism, Permian, Siberia, SHRIMP.

1 INTRODUCTION

The Pangaea supercontinent was assembled by the Late Palaeozoic through the closure of the Rheic Ocean between Gondwana and Laurussia (McElhinny & McFadden 2000). At around the same time, the Siberian Craton and Kazakhstan microcontinent joined Laurussia through the closure of the Uralian Ocean (e.g. Puchkov 1997). However, the precise history of ocean closure is not known because of a lack of precisely dated reliable Early Permian palaeomagnetic poles from the Siberian Craton (Smethurst *et al.* 1998). Only 10 Siberian palaeopoles, with estimated ages between 300 and 260 Ma, are present in the latest version of the Global Palaeomagnetic Database (Pisarevsky 2005), and all of them are poorly dated and derived from blanket cleaning experiments. Because of their dubious reliability, Smethurst *et al.* (1998) did not include any of them in their compilation and construction of the Siberian Apparent Polar Wander Path (APWP). More recently, Kravchinsky *et al.* (2002) reported a palaeomagnetic pole from the Alentuy Formation (the sampling location is shown in Fig. 1b) of the Trans-Baikal area, supported by a positive fold test. As nearly all of their samples yielded steep upward remanence, they suggested that the Alentuy Formation corresponds to the end of the Kiaman superchron (>265 Ma according to the new geologic timescale of Gradstein *et al.* 2004). Kravchinsky *et al.* (2002), assuming that the Siberian Craton was already an integrated part of Eurasia, compared their pole with the Eurasian APWP of Van der Voo (1993) constructed from European poles. They suggested a possible ∼29° rotation of the Alentuy area with respect to the Siberian Craton. However, the difference between the Alentuy pole and the Eurasian APWP may also reflect that the Siberian Craton was not yet completely integrated into Eurasia.

Large-scale magmatic events of Carboniferous–Permian age are reported from Trans-Baikalia (e.g. Zorin 1999; Litvinovsky *et al.* 2002; Yarmolyuk *et al.* 2002). Granitoids and bimodal volcanics of ∼300–260 Ma are found in wide NE striking strips in Trans-Baikalia (Fig. 1b), including two large dyke belts (Shadaev *et al.* 2005), but no traces of this magmatic event has yet been reported from the cratonic part of south Siberia.

Here we present the results of a palaeomagnetic study and U–Pb zircon geochronology of a series of mafic dykes exposed near the southwestern corner of Baikal Lake (Figs 1c and d). Our data show that these dykes are coeval with the Trans-Baikalian 300–260 Ma magmatic event, and their palaeomagnetism provides the first precisely dated 275 Ma Siberian palaeopole.