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Paleomagnetism of Cryogenian Kitoi mafic dykes in South Siberia: Implications for Neoproterozoic paleogeography

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ABSTRACT

We present a new paleomagnetic pole of 1.1°N, 22.4°E, A_{95} = 7.4° from the 760 Ma gabbro-dolerite Kitoi dykes located in the southern part of the Siberian Craton. The pole is supported by contact tests and suggests closer position of Siberia relative to Laurentia at 760 Ma than in Mesoproterozoic. We propose that this closer configuration was achieved by dextral transpressive motion of Siberia relative to Laurentia between 780 and 760 Ma. This motion was probably initiated at the first stage of the Rodinia breakup and is coeval with the 780 Ma Gunbarrel magmatic event of the western Canadian shield.

1. Introduction

According to most Neoproterozoic paleogeographic models, the Rodinia supercontinent finally amalgamated at 1000–900 Ma and started to break up at 800–750 Ma, although the exact timing of these events and the precise configuration of Rodinia are controversial (e.g., Hoffman, 1991; Dalziel, 1997; Pisarevsky et al., 2003; Li et al., 2008). The role and place of Siberia in these events is a key part of this long-lasting controversy. Most workers suggest that Siberia was juxtaposed with the northern margin of Laurentia controversy (e.g., Hoffman, 1991; Condie and Rosen, 1994; Frost et al., 1998; Rainbird et al., 1998; Pisarevsky et al., 2008; but see Sears and Price, 2000), but a more precise reconstruction is hindered by the lack of early and middle Neoproterozoic paleomagnetic data.

Although reliable ca. 1500–1450 Ma and ca. 1050–950 Ma paleomagnetic data from Siberia and Laurentia (Table 2; see also Pavlov, 1994; Ernst et al., 2000; Veselovsky et al., 2003) support coherent movement of these two continents during most of Mesoproterozoic, they also suggest a paleolatitudinal separation, implying the presence of some other continental block(s) in between (Wingate et al., 2009). The apparent absence of any exposures of the giant 1267 Ma Mackenzie igneous event in Siberia supports this inference (Gladkochub et al., 2006a, 2006b; Pisarevsky et al., 2008). However, the 710–730 Ma mafic igneous rocks along the southern margin of Siberia (Neimark et al., 1990; Rytsk et al., 2002; Ernst et al., 2012) may be related to the Laurentian 723 Ma Franklin giant igneous event. If so, at ca. 720 Ma Siberia may have been closer to Laurentia than it was in Mesoproterozoic, a hypothesis that would have major implications for Neoproterozoic reconstructions and for models of Rodinia breakup. Some reliable ca.790–720 Ma paleomagnetic data from both continents are therefore needed to test this hypothesis. Sklyarov et al. (2003) reported a 743 ± 47 Ma Sm–Nd isochron age and a 758 ± 4 Ma $^{40}Ar–^{39}Ar$ plateau age for mafic dykes along the

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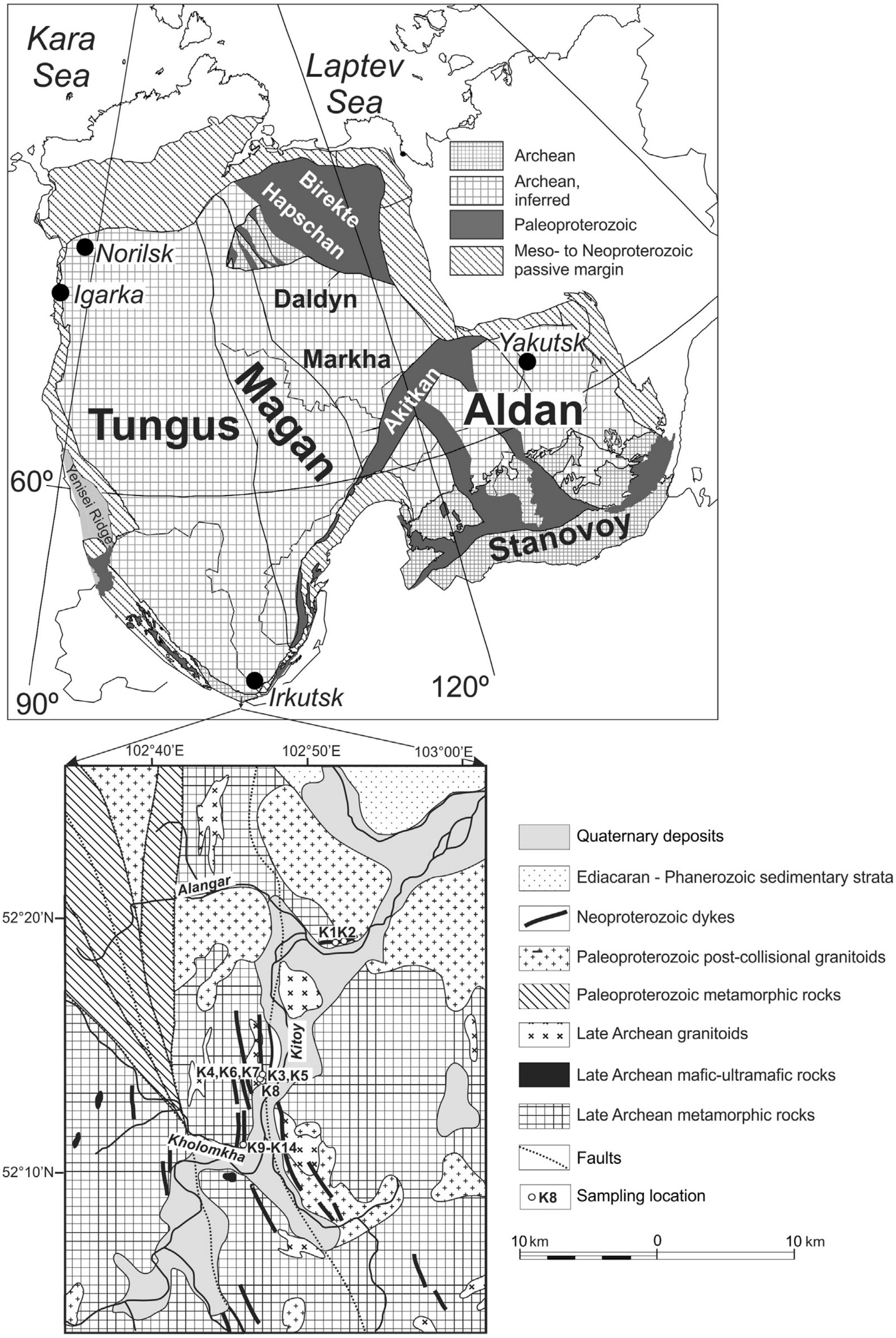

Fig. 1. (a) Precambrian tectonic and paleogeographic elements of the Siberian Craton and (b) geology of the study area and sampling localitie.

Kitoi River in the Sharyzhalgai massif of the southern Siberia (Fig. 1) which may be related to the Franklin event. A pilot study of these dykes (Konstantinov, 2006) demonstrated the presence of a stable paleomagnetic remanence. In this paper we present results of a 2009 field study in which we carried out a detailed paleomagnetic sampling of the Kitoi dykes with the purpose of obtaining a highly reliable Cryogenian paleomagnetic pole for Siberia.

2. Geology and sampling

The Siberian Craton (Fig. 1a) is a Paleoproterozoic collage of mostly Archaean granulite–gneiss and granite–greenstone complexes (Rosen et al., 2005) surrounded by major Phanerozoic suture zones (Zonenshain et al., 1990; Parfenov, 1991). The basement is exposed only in two shields, Aldan–Stanovoy and Anabar, and in