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Paleomagnetism of Mesoproterozoic margins of the Anabar Shield: A hypothesized billion-year partnership of Siberia and northern Laurentia

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ABSTRACT

Siberia and Laurentia have been suggested as near neighbors in Proterozoic supercontinents Nuna and Rodinia, but paleomagnetic evidence has been sparse and ambiguous. Here we present four new paleomagnetic poles from undeformed Paleo-Mesoproterozoic (lower Riphean) sedimentary rocks and mafic intrusions of the northwestern Anabar uplift in northern Siberia. Combining these results with other Proterozoic data from Siberia and Laurentia, we propose a tight juxtaposition of those two blocks (Euler parameters 77°, 098°, 137° for Anabar to North America) spanning the interval 1.7–0.7 Ga, constituting a long-lived connection that outlasted both the Nuna and Rodinia supercontinental assemblages.

1. Introduction

Proterozoic continental reconstructions are crucial for understanding long-term Earth history, but their development has occurred over decades with some major components yet unresolved, including precise configurations of the supercontinents Nuna and Rodinia (reviewed by Evans, 2013). Paleomagnetic data are an integral component of such reconstructions, but the Proterozoic database has been dominated by results from Laurentia and Baltica (Buchan, 2013). The present study addresses reconstruction of Siberia, one of the major Proterozoic cratons. Siberia's paleogeographic relationship to Laurentia has been contentious, with juxtapositions ranging from Laurentia's western margin (Sears and Price, 1978, 2000, 2003) to its northern margin in a variety of orientations (Hoffman, 1991; Condie and Rosen, 1994; Frost et al., 1998; Rainbird et al., 1998).

In the past 15 years, paleomagnetic data have strongly supported a mid-Proterozoic location of Siberia near Laurentia's northern margin, such that southern Siberia faced northern Laurentia (Gallet et al., 2000; Ernst et al., 2000; Pavlov et al., 2002; Metelkin et al., 2007; Wingate et al., 2009; Didenko et al., 2009). An unresolved issue is whether such a fit is loose, in which the two cratons were separated by several thousand km (Pisarevsky and Natapov, 2003; Pisarevsky et al., 2008) or tight (Pavlov et al., 2002; Metelkin et al., 2007; Evans and Mitchell, 2011). The loose-fit hypothesis is inspired primarily due to a perceived incongruity between 1.1 and 1.0 Ga poles from the two cratons, but as will be described further, such a conclusion rests on ages of Siberian sedimentary strata with rather poor constraints. Evans and Mitchell (2011) proposed the two cratons to be tightly joined in Nuna but separating through the interval 1.38–1.27 Ga—the era of numerous mafic intrusive events throughout Laurentia, Siberia, and neighboring Baltica—to achieve the more distant relative position apparently required by the 1.1–1.0 Ga poles. Nonetheless, the matching LIP "barcode" record spanning 1.7–0.7 Ga from Laurentia and Siberia (Gladkochub et al., 2010a; Ernst et al., 2016a) may alternatively suggest a tight fit between the two blocks enduring as late as 0.7 Ga. A relative lull in tectonic activity or sedimentary record (e.g. passive margins) in southern Siberia throughout that interval could also suggest that margin's location within a continental interior (Gladkochub et al., 2010b). It is more difficult to apply the same test to northern Laurentia, because that margin is largely covered by Phanerozoic strata (e.g., Kerr, 1982).

The purpose of this paper is to report new paleomagnetic data from nearly pristine igneous and sedimentary rocks of the Anabar uplift in northern Siberia, to assess the aggregate paleomagnetic

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