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Ages of detrital zircons (U/Pb, LA-ICP-MS) from the Latest Neoproterozoic–Middle Cambrian(?) Asha Group and Early Devonian Takaty Formation, the Southwestern Urals: A test of an Australia-Baltica connection within Rodinia

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ABSTRACT

A study of U-Pb ages on detrital zircons derived from sedimentary sequences in the western flank of Urals (para-autochthonous or autochthonous with Baltica) was undertaken in order to ascertain/test source models and paleogeography of the region in the Neoproterozoic. Samples were collected from the Ediacaran-Cambrian(?) age Asha Group (Basu and Kukkarauk Formations) and the Early Devonian-aged Takaty Formation.

Ages of detrital zircons within the Basu Formation fall within the interval 2900–700 Ma; from the Kukkarauk Formation from 3200 to 620 Ma. Ages of detrital zircons from the Devonian age Takaty Formation are confined to the Paleoproterozoic and Archean (3050–1850 Ma). Potential source regions for the Asha Group detrital zircons include the Eastern European platform, Amazonia and West Africa based on 'archetypal' Rodinia reconstructions and Late Neoproterozoic paleogeographic models. An alternate proposal places Australia adjacent to Arctic/Uralian margin of Baltica (so-called Australia upside-down concept).

A comparison between detrital zircon populations from the Asha Series and East European Platform source regions demonstrate an unusual dichotomy in that distal sources appear to contribute more zircon than near source regions. This dichotomy is examined and we note that Australia contains source regions of the proper age range to match the Uralian signal and therefore, the placement of Australia against the Arctic/Uralian margin of Baltica is compatible with the detrital zircon record. We also note that an Ediacaran position of Baltica against Australia presents a paleogeographic conundrum and therefore if the Australia upside-down concept is reasonable, the breakup between Australia and Baltica must have occurred prior to the Ediacaran and most likely in the 700–750 Ma interval.

Although sedimentary strata of the southwestern form a continuous section, the spectrum of detrital zircon ages within the Asha Group and Takaty Formation indicates major changes in basinal source and structure. The basin was most likely an intracontinental) basin during the Tonian/Cryogenian interval and perhaps into the Ediacaran. Later, during accumulation of Takaty Fm. (Early Devonian), the basin formed along a passive margin with input from the western side of the East European Platform.

1. Introduction

The eastern boundary of East European Platform (EEP) is the present-day N-S trending Ural Mountains (the Urals; Fig. 1). The Uralide Orogen is a part of the Paleozoic fold-thrust belt formed during the final stages of northern Pangea assembly. During this orogenic cycle, the Uralian Ocean closed between Baltica-Laurentia and Siberia-Kazakhstania along the Uralian suture (or Main Uralian Fault; Hamilton, 1970; Zonenshain et al., 1990; Sengör et al., 1993; Puchkov, 2000, 2002, 2009, 2010; Kuznetsov et al., 2010a; Görz and Hielscher, 2010).

The Uralian orogeny exposed Late Cambrian to Late Paleozoic rocks that collectively form the Uralides. In contrast, older rock complexes in, and west of, the Urals are collectively named the Pre-Uralides-Timanides. The Pre-Uralides-Timanides are separated from the Uralides either by stratigraphic differences or structural boundaries. The subdivision between the two was initially made by Kheraskov (1948).

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Along strike, the Urals is subdivided into the *Eastern-Uralian* and *Western-Uralian* (~western slope of the Urals) megazones. The *Main Uralian Fault* separates the two regions. The eastern Uralides are mostly covered by younger sediments, but are generally thought to be allochthonous with respect to the Uralian edge of the Baltica-Laurussia. The Western-Uralian megazone contains both the Uralides and the Pre-Uralides-Timanides.

Many geological aspects of the Uralides (e.g., relations of individual sequences of different scale, their biostratigraphic and isotopic-geochronological characteristics) are presently well understood and led to a reasonably coherent geodynamic history of the Uralide Orogeny (see the most recent review-articles Brown et al., 2006; Fershtater et al., 2007, 2010; Puchkov, 2002, 2009, 2010; Ryazantsev et al., 2008, 2012). Even so, many key questions regarding the Pre-Uralian history (recorded and partially preserved in Pre-Uralides–Timanides complexes) remain to be answered or are still debated. Among the debated topics are the duration of the Uralian Ocean and existence of a Paleo-Uralian ocean that closed prior to the opening/closing of the Uralian Ocean. Some researchers argue that Uralian Ocean opened in the Ordovician (Ivanov et al., 1986; Puchkov, 2002, 2010; and others), whereas others believe there was a "Pre-Uralian" ocean that opened in the Late Precambrian (Samygin and Leites, 1986; Samygin and Ruzhentsev, 2003; Samygin and Kheraskova, 2005; Kuznetsov, 2009). The late Precambrian to Cambrian sedimentary basins now occupying the western Uralian megazone may hold key clues that can help trace the pre-Ordovician history of the Uralian margin.

Our examination of the early evolution of the Uralian margin is inextricably tied to the tectonic history of the EEP and its relationship to the assembly and dispersal of the Columbia (Rogers and

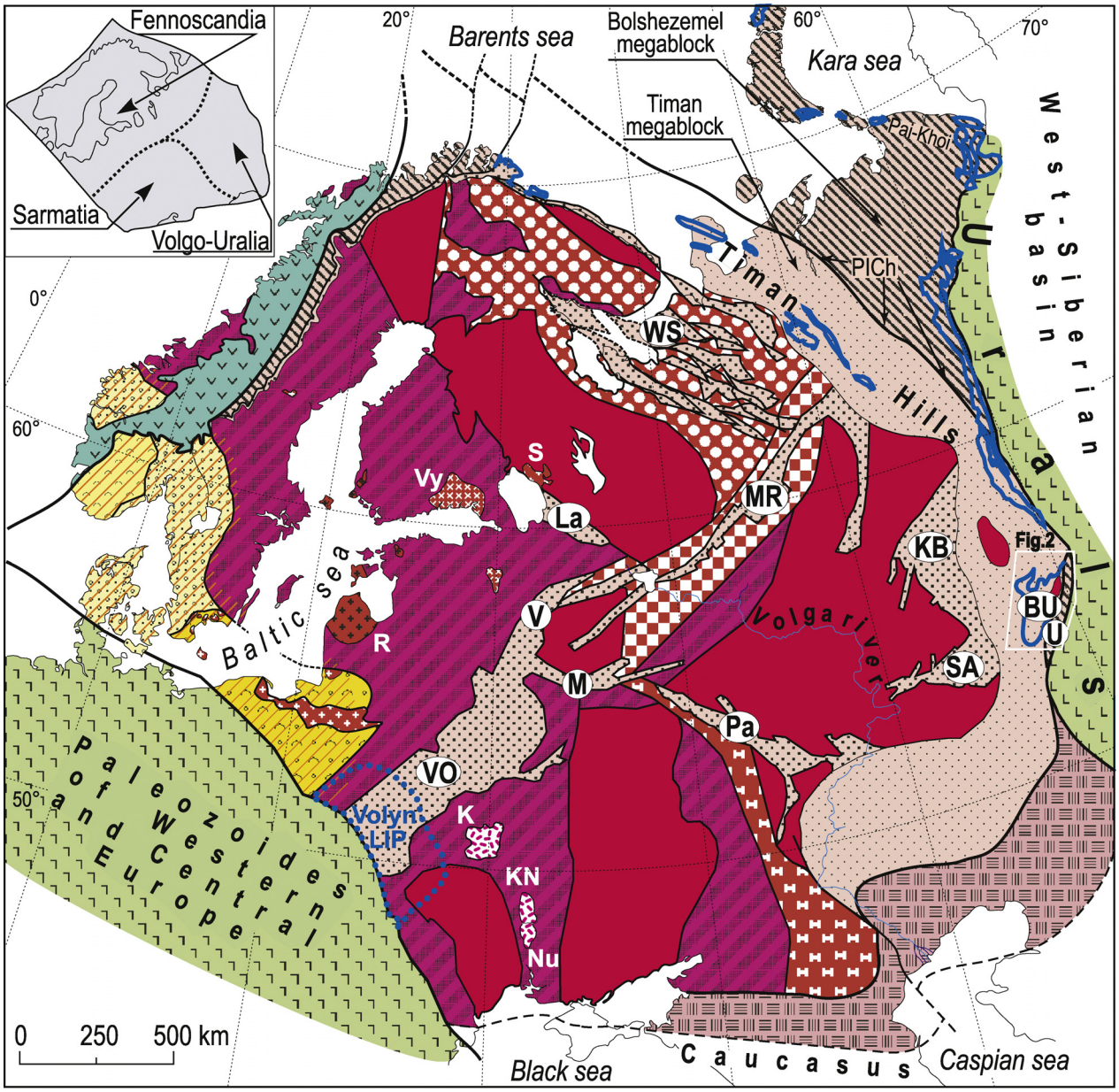

Fig. 1. Map of the main basement complexes and structures of the East European Platform (EEP) and its periphery, including blocks of consolidated basement, rift structures, and Neoproterozoic and Paleozoic fold-thrust belts (modified from Kuznetsov et al., 2010a). Late Paleoproterozoic–early Neoproterozoic complexes of the EEP from Bogdanova et al. (2008). Neoproterozoic–Middle Cambrian complexes at the eastern and northeastern periphery of the EEP after Kuznetsov et al. (2007) and Kuznetsov (2009). Configuration of the White Sea Rift System after Baluev (2006). Insert: Contours of EEP proto-cratons Fennoscandia, Sarmatia and Volga-Uralia simplified from Bogdanova et al. (2008). Plutons: K, Korosten; KN, Korsun'-Novomyrgorod; Nu, Novoukrainskiy; Vy, Vyborg; R, Riga; S, Salmi; B, Bornholm.