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Geochronological, geochemical and isotopic study of detrital zircon suites from late Neoproterozoic clastic strata along the NE margin of the East European Craton: Implications for plate tectonic models

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ABSTRACT

U/Pb dating, REE geochemistry and Lu/Hf isotopic studies utilizing LA-ICPMS on detrital zircon suites from Neoproterozoic siliciclastic rocks from the northeast periphery of the East European Craton (sandstones of Djejim Formation, Djejim-Parma Hills, Southern Timan Ridge and sandstones of the Engane-Pe Formation, Northern Engane-Pe uplift, Polar Urals) are used to assess the provenance of sediments and test tectonic models for the late Precambrian assembly of continents. The data support the conclusion that Neoproterozoic complexes of the Timan–Pechora region (TPR) are composed mainly of sedimentary rocks (*SW Pre-Uralides–Timanides*) eroded from Baltica and deposited along the passive margin of Baltica. However, late Precambrian–Early Cambrian volcanic-sedimentary and volcanic rocks, granitoids, and rare ophiolites of the TPR (*NE Pre-Uralides–Timanides)* comprise more juvenile material developed some distance from Baltica. Important differences exist between the U/Pb ages and Lu/Hf isotopic systematics of zircons from rocks of the NE Pre-Uralides–Timanides and the Neoproterozoic complexes of the Peri-Gondwanan terranes and do not support a Peri-Gondwanan origin for the NE Pre-Uralides–Timanides. In our interpretation, the SW Pre-Uralides–Timanides were deposited in the Neoproterozoic along the passive Timanian–Uralian margin of Baltica, but the NE Pre-Uralides–Timanides were formed along the active (Bolshezemel) margin of a paleocontinent called Arctida and were caught in the collision zone between the two paleocontinents, Arctida and Baltica.

1. Introduction

The Timan–Pechora region (TPR) is a triangular-shaped area located along the northeastern periphery of the East European Craton. The TPR includes the Timan Ridge region, the Pechora Basin, the near-shore marine areas of the Barents, Pechora and Kara seas, and the western slopes of the North, Sub-Polar and Polar Urals (Figs. 1 and 2). The TPR lies between two large cratons of Northern Eurasia: the East European and the Siberian cratons. The Ural Mountains represent a younger superimposed Paleozoic fold-thrust belt, which is also located between those two cratons.

There is a general consensus that the northern part of Wegener's Pangea (the late Paleozoic framework of present-day northern Eurasia and its Arctic shelves) was formed as a result of the assembly of several large Precambrian and early Paleozoic paleocontinents — Baltica (the Precambrian shield of East European Craton), Laurentia (Precambrian shield of North America), Siberia (Precambrian shield of Siberian Craton), Kazakh–Kyrgyz (a composite middle Paleozoic paleocontinent) and smaller terranes of different origins (micro-continents, oceanic arcs, fragments of oceanic basins, etc.). Those smaller terranes are involved in Phanerozoic orogenic belts that lie between the more ancient cratonic shields and along their edges. At the beginning of the Mesozoic, Pangea began to fragment. Opening of the Atlantic Ocean first separated North and South America from the Pangea supercontinent, and then, in the late Mesozoic and Cenozoic, oceanic rifting in the Atlantic propagated into the Arctic where new ocean basins (the Eurasia and Amerasia) were formed.

Thus, the northern margin of the ancient (Precambrian) cratonic shield of northern Eurasia formed as a result of late Neoproterozoic to Phanerozoic accretion, collision and rifting. Part of the geodynamic history of this northern margin has been reconstructed, but many questions remain to be answered. For example: (1) How many oceanic arcs and back-arc basins were collapsed to form the Phanerozoic orogenic belts? (2) What was the nature (passive or active?) of the colliding margin of the continents involved? (3) Are there, and what is the origin of, exotic terrains in the collisional orogenic belts? Thus, the sequence of events and the details of those events involved in the formation of this margin (including the TPR)

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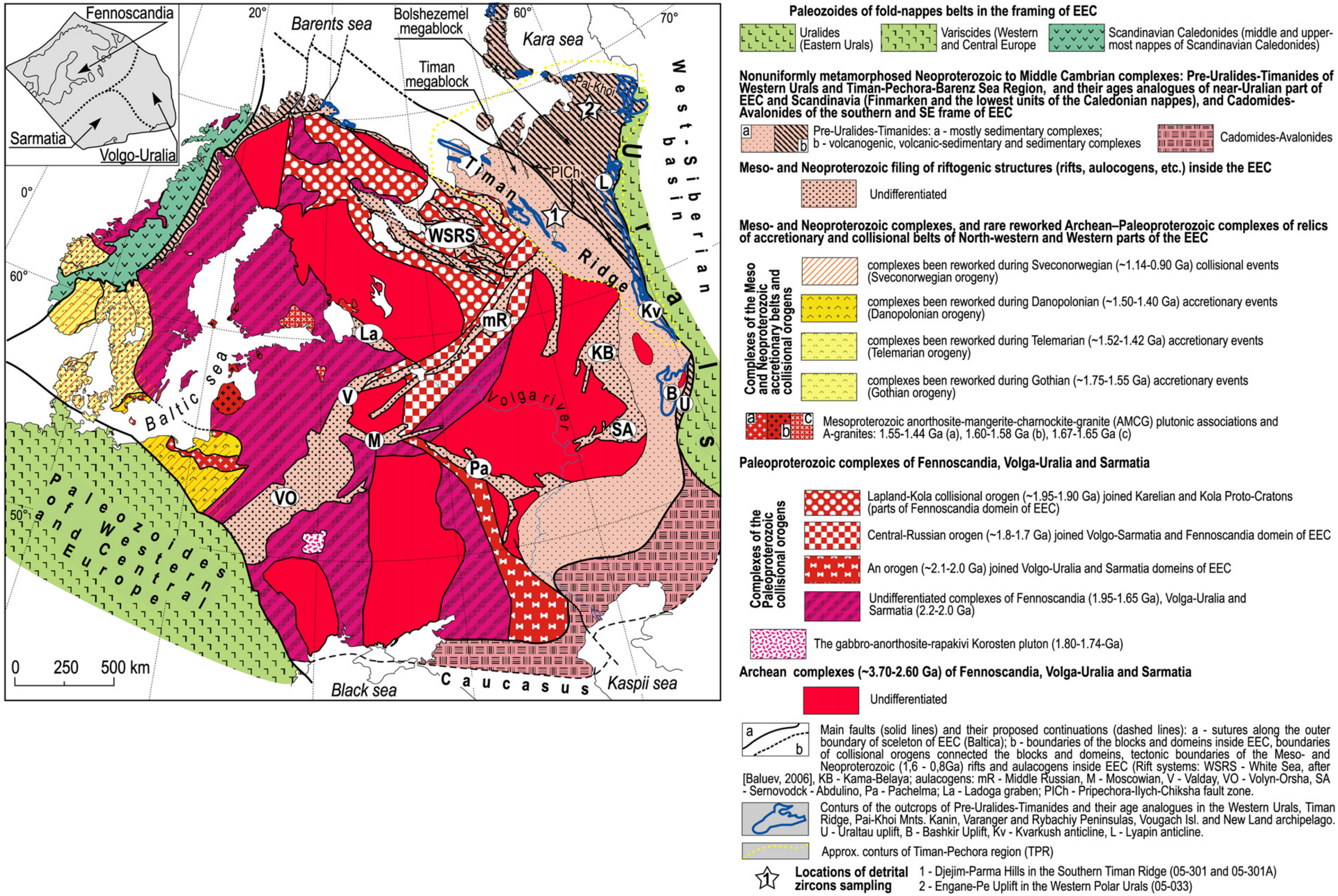

Fig. 1. Map of the main complexes and structures in the basement of the East European Craton and its periphery, including blocks of consolidated basement, rifted structures, and Neoproterozoic and Paleozoic fold-thrust belts. Late Paleproterozoic–early Neoproterozoic complexes of EEC from Bogdanova et al. (2008). Neoproterozoic–Middle Cambrian complexes at the eastern and northeastern periphery of the EEC after Kuznetsov et al. (2007a) and Kuznetsov (2009a,c). Configuration of the White Sea Rift System (WSRS) after Baluev (2006). Insert: Contours of EEC proto-Cratons Fennoscandia, Sarmatia and Volga-Uralia simplified from Bogdanova et al. (2008).