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Arc–continent collision in the Urals: Peculiarities in development along the orogen strike

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The Tagil and Magnitogorsk island-arc systems adjacent to the Uralian margin of Baltica have originated in the Paleozoic. The first system born in the terminal Ordovician above a subduction zone dipping toward the Baltica extended from the polar segment via northern one to the middle Urals inclusive. It went through all the evolutionary stages being magmatically active during $\sim$ 35 Ìà. Suprasubduction volcanism of that system lasted from the Latest Ordovician to the commencement of the Early Devonian inclusive. Mafic-ultramafic massifs of the Platinum belt intruded the arc rear zone 432–415 Ìà ago according to isotopic ages of their gabbroids [1]. Island uplifts caped by carbonates with bauxite deposits emerged in the system in the Early–Middle Devonian. The Tagil arc was situated 500–1000 km [2] away from the Baltica shelf outer boundary, being separated from continent by the Salatim back-arc marginal basin floored by oceanic crust. Events of arc–continent collision during an active period of the Tagil arc evolution have not been established.

The Magnitogorsk island-arc system was interrelated in origin with a younger (Devonian) subduction zone that appeared further away from the Baltica than the Tagil zone and was inclined in opposite direction. This system extended throughout the periphery of the Uralian paleoocean, its South Uralian part inclusive. Being born above oceanic crust in the southern Urals, the Magnitogorsk arc evolved during 45 Ìà in the Emsian–Famennian time. Axis of volcanism migrated toward ocean during this time, i.e., in the dip direction of subduction zone that periodically was inclined at lower angles. In the southern Urals, where the Tagil arc was absent, the Magnitogorsk one situated not far away from the Baltica margin [3] sheltered the Prisakmara-Voznesensk marginal basin from paleoocean. Sea-floor spreading in that fore-arc marginal basin terminated

by the Middle Devonian. Afterwards the distance decrease between the Magnitogorsk arc and paleocontinent was accompanied by formation of accretionary prism that involved crustal fragments of the Prisakmara-Voznesensk oceanic basin including numerous tectonic slices and sheets of ophiolites. The arc–continent collision took place in the Famennian. Sequences of polymictic graywacke flysch and interrelated olistostrome facies had accumulated since that time above the accretionary prism and on the Baltica margin. Clastic material derived from the island arc and uplifts of accretionary prism included the erosion products of a subcontinental HP-LT complex that originated under conditions of transpression [4]. The arc–continent collision blocked the subduction zone and caused cessation of suprasubduction volcanism. Initial obduction of imbricated accretionary fore-arc complexes onto the continental slope and shelf commenced in the Early Carboniferous concurrent to formation of the Main Uralian Fault or suture zone, which separated the continental margin from island-arc complexes instead of the former Prisakmara-Voznesensk basin.

In the middle Urals, magmatic activity of the Devonian arc was not so long (D_1e_2-D_3f_1) as in the southern segment. Here and in the northern Urals, the arc was most remote from the Baltica, and the Tagil inactive arc was situated in between. When the remnant arc and Devonian island-arc system collided owing to subduction beneath the latter, disintegration and consumption of relevant inter-arc basin resulted in formation of the Serov-Mauk ophiolite suture. Subsequent appearance of new subduction zone behind the Tagil arc caused migration of the Baltica margin toward the coupled island-arc ensemble with Tagil complexes in its front. The arc–continent collision commenced in the Frasnian and terminated in the Tournaisian [5]. It developed without obduction events. The narrow zone of greenstones and blue schists that replaced the Salatim marginal basin is know also as zone of the Main Uralian Fault.

Another scenario characterizes tectonic development of the continent–ocean transition in the Polar Urals. The Devonian Voikar arc originated here earlier than in southerly segments, soon after the Silurian Tagil arc, and more close to it. The latter was involved into the Devonian subduction zone and then included into the accretionary complex of the Voikar arc at the early stage of its evolution. Magmatic activity of this arc lasted ~ 40 Ìà (D_1–$D_{2-3?}$). According to known Rb-Sr dates, a tabular granodiorite-tonalite intrusion was emplaced into basal rocks of the Voikar arc 400–385 Ìà ago [6]. Subduction under this arc led to consumption of the Salatim marginal basin and arc–continent collision. The collision events were interrupted by formation of the Uralian-Arctic oceanic basin in the initial Late Devonian [7] at the site of junction between the Cadomian margin of Baltica and Middle Paleozoic accretionary prism. This, comparatively small basin existed until the Visean, and after its closure the island-arc complexes with large ophiolite allochthons at the base were obducted onto the Baltica margin. In front

of the obducted rock bulk, there were deposited graywackes (Visean), and metamorphic HP-LT rocks and minerals with the early Carboniferous dates [8, 9] were formed in underlying complexes.

In general, the Urals segments under consideration were comparable in the Early–Middle Paleozoic with the Melanesian junction zone between the Australian and Pacific plates, where island arcs of diverse polarity recurrently have originated in different regions and the present-day lengthy island-arc garland is situated above subduction zones dipping toward ocean.

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