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Late Devonian tectonics of the southern East European Craton and its margins

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The first important Phanerozoic tectonics affecting the Precambrian East European Craton (EEC) occurred in Late Devonian times with a widespread rifting event, recorded in the Pripyat-Dniepr-Donets rift, the Timan-Pechora and Eastern Barent Sea basins, and most likely in the Peri-Caspian Basin. There is no explicit evidence of rifting in the last of these except for a rapid increase of subsidence. Late Devonian rifting of the Karpinsky Swell is not documented by normal faulting, associated pre-rift, syn-rift and post-rift sedimentary architecture and magmatism such as for the Dniepr-Donets rift. However, seismic data between the two basins show their continuity. It seems possible that this widespread rifting event also affected areas on the subsequently tectonically overprinted southern margin of the EEC such as Crimea, the Greater Caucasus and perhaps the North Dobrogea. Highly dismembered and metamorphosed mafics to ultramafics crop out in the Greater Caucasus and are interpreted as remnants of a small Devonian oceanic basin. Devonian deep-water turbidites and magmatics crop out in North Dobrogea and drill holes on the Crimean plain penetrate Devonian deep-water shales and volcanics. These units are all consistent with a rift setting. Geochemistry of magmatic rocks, subsidence modelling and structural relationships between sediments, faults and magmatic bodies of the Donets basin all favour an ‘active’ rifting process. This implies that excess temperatures at the base of the lithosphere were involved in the initiation of rifting. Although the concept of a Late Devonian mantle plume has been proposed, many authors have also suggested that rifting in the EEC was somehow facilitated by its ‘back-arc’ position behind the conventionally postulated active convergence-subduction belt along the Urals and from Greater Caucasus to Dobrogea at this time. Both these geodynamic scenarios – mantle plume and mantle flow behind a subduction system – involve the presence of thermal

perturbations in the mantle beneath the lithosphere. In this respect, they are similar except that a mantle plume *sensu stricto* implies a more discrete source at a deeper level. That Late Devonian magmatism is so widespread on the EEC and its margins argues against a conventional plume model that would be associated with one well-defined 'hot-spot'. As regards a 'back-arc' scenario, this is also problematic. Recent studies on the Urals suggest that Devonian subduction was beneath the Magnitogorsk intra-oceanic volcanic arc, away from and not towards the EEC and that accretion of the arc to the margin occurred in the Late Devonian. There is also little compelling evidence that the southern margin of the EEC was the hanging wall of an active subduction zone at this time, despite the fact that it has very often been adopted as such in plate kinematic models. The closest a subduction zone would be at this time is south of the Transcaucasus area and it seems unlikely to be responsible for widespread peri- and intra-cratonic magmatism elsewhere. What can be said with some certainty is that by the Late Devonian the western margin of the EEC is already sutured (with Laurentia-Avalonia-Moesia?), that the eastern margin is under compression (Southern Urals). The thermal state of the underlying asthenosphere was probably in a state of flux in such a scenario. The possible imposition of a mantle plume (or broader, plume-like thermal perturbation from deeper in the mantle) would only serve to destabilize the situation further and perhaps this is sufficient, plume or not, to explain the character and distribution of rift-related magmatism on the EEC and its margins at this time.