Ediacaran paleosols of the EEC: Geochemical evidence of paleoclimate and major release of phosphorus into the Ediacaran ocean

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Paleosols are fossil soils, remnants of ancient soils (weathering crusts) and unlike marine sediments they are formed on land providing direct evidence of climatic and environmental conditions during weathering.

Paleosols studied here were found on top of the Ediacaran basalt trap, 140 thousand km^2 and up to 500 m of lavas and volcanoclastics, which covers the western margin of the East European Craton. The studied paleosol profiles were accessed from drillcores located in NW Ukraine (7 profiles) and E Poland (1 profile). They are unique among the Precambrian paleosols because their age is well constrained around 550 Ma and most of them are unaffected by burial diagenesis. They are reddish colored, on average ca. 10 (up to 30) meters thick and most of them are characterized by a well-developed and well-defined alteration sequence with a lateritic uppermost horizon indicated by Chemical Index of Alteration – CIA [1] values reaching 95.

Several meters thick kaolinite and hematite-rich paleosol profiles are usually interpreted to represent intense weathering in tropical climate. Fe^{2+}/Fe^{3+} ratio decrease to 0 confirms that weathering took place under oxidative conditions. Geochemical mass-balance analysis shows that major element enrichment-depletion trends are similar to modern deeply weathered tropical soil profiles. For those reasons these Ediacaran paleosols can be interpreted to be indicative of hot and humid climate.

Over 50% of the basalt mass is dissolved during this weathering process. Mass-balance calculations of the studied paleosol profiles suggest >90% of P loss in the top saprolitic layer. Given the area of the basalt trap, this reflects a significant release of P into the Ediacaran ocean, which possibly contributed to the Ediacaran life explosion and atmospheric O_2 rise.

[1] Nesbitt & Young (1982), *Nature* **299**, 715-717.

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