Weathering intensity in the Mesoproterozoic and modern large-river systems: A comparative study in the Belt-Purcell supergroup

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River systems are the main contributors of continental siliciclastic sediments to ocean basins, and potentially preserve a record of weathering conditions across the catchment areas. Proterozoic rivers have been viewed as mostly braided systems due to the lack of influence of rooted vegetation that produces fast channel lateral migration, high run-off rates, and low bank stability. Many large-scale Proterozoic siliciclastic basins are preserved, formed by river systems up to pan-continental scale. However, their significance as archives of continental weathering intensity remains under explored.

This study evaluates secular weathering variations for the Mesoproterozoic based on the Chemical Index of Alteration (CIA), accounting for post-depositional K addition and specifically for siliciclastic units of the Belt-Purcell Supergroup (BPS). BPS CIA values throughout the succesion span 60-85, averaging ~70. These values could be linked to CO_2 emissions from magmatism accompanying rifting of Columbia at ~1.4 Ga. The new data, along with K-corrected CIA data from the literature, could be interpreted as recording a rising trend from ~50 at ~2.5 Ga to ~75 at 1.6 Ga, a low of 50 at ~1.5 Ga, and ~50-60 from 1.4 Ga to 1.0 Ga. However, CIA link to global geodynamic events remains challenging due to scarcity and lack of space-time resolution of data sets.

BPS CIA values of ~70, are commensurate with modern large river systems such as the Orinoco, Nile and Amazon rivers. The Appekunny and Grinnell formations (Lower BPS succesion) display two intense weathering periods (~80±5) equivalent to humid-dry tropical conditions in modern rivers such as the Orinoco, Parana, Mekong and Amazon rivers, with a arid-template climate period in between.

This study suggests that BPS CIA values reflect a more aggressive chemical weathering, since Proterozoic rivers had less sediment residence time due to lack of vegetation cover, and therefore, faster transport time than their modern counterparts. To achieve high CIA values in shorter periods of time without vegetation cover, higher chemical weathering conditions need to be invoked.

Geodynamic implications of >1 Ga Re-Os model ages in PGM from the Dobromirtsi Ultramafic Massif, Central Rhodope, Bulgaria

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The Dobromirtsi Ultramafic Massif is a relic of meta-ophiolitic mantle, located in the Central Rhodope Dome in southern Bulgaria. The ultramafics have been trust over Paleozoic (470-450 Ma; [3]) para-gneisses and are unconformably covered by Tertiary volcano-sedimentary rocks. The massif consits of strongly metamorphosed (greenschist to amphibolite facies) harzburgite and dunite, containing several chromititite pods, and cross cut by pyroxenite veins [2].

Os-rich laurite $(Ru,Os)S_2$ ± Os-Ir alloys ± pentlandite constitute the PGM assemblage in unaltered chromite. In altered zones, Os-poor partially desulfurized laurite, sometimes replaced by Ru-rich base-metal sulfides + Os-Ir alloys is the common assemblage [1].

In situ Re-Os analyses reveal that unaltered laurite has a small spread in T_{RD} (300-600 Ma). In contrast, 11 out of 36 of the altered grains yield T_{MA} (and T_{RD}) model ages > 1Ga and up to 2.2 Ga ($^{187}Os/^{188}Os$ = 0.1124- 0.1206; average = 0.1173 ± 0.003; 2σ). These unradiogenic Os signatures requiere a mantle source that underwent differentiation processes in the Proterozoic; we suggest tha this source lies in the ultramafic rocks surronding the chromitites and that hydrothermal fluids sequester this signature when it infiltrate the peritotite. The referred source would correspond to the sub-continental mantle beneath Gondwanaland. To the best of our knowledge, this is the first Os-isotope evidence of Gondwanaland terrains in Central Rhodope, as has been argued but not proved by Cherneva & Georgieva [4].

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