Tracing formation conditions of Paleoproterozoic P-rich deposits be Rare Earth elements, Zaonega Formation, NW Russia

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One of the oldest occurrences of P-rich sedimentary rocks in Earth's history is found in association with sediments rich in organic matter in the 2.0 Ga Zaonega Formation (Fm), Karelia, Russia (Lepland et al., 2013, 2014). In this study we report the REE distribution within the upper part of the Zaonega Fm where P-rich intervals occur within siliciclastic and carbonate rocks.

The REE concentrations were measured by ICP-MS with Agilent 7500c (USA) for the bulk samples. The REE abundances in studied samples are negatively correlated with CaO, but have a strong positive correlation with FeO suggesting, that REEs were carried into the sediments as adsorbed onto the iron oxides (f.e.Bau, 1999) rather than by carbonates. Thus REE patterns in studied samples display geochemical signature of the depositional setting. The P-enriched horizons exhibit the lowest REE concentrations, possibly due to carbonate dilution. The shape of REE profile from P-rich horizons have a significant positive Eu anomaly, negative Ce anomaly and MREEs>LREEs. The magnitude of Cean through the studied stratigraphic interval does not demonstrate significant variation and no strong correlation with P. However, the magnitudes of positive Euan correlates with P-contents. Similar positive Euan values have been reported for P-rich outcrop section of the upper Zaonega Fm by Joosu et al. (2015). Thus, positive Euan is not the local characteristic, but is typical for the P-rich horizons throughout the Zaonega depositional setting. Positive Euan in silicicalstic sediments has commonly been interpreted to reflect of reducing -anoxic conditions of water column (Sverjensky, 1984). Eu can be mobile in hydro-thermally affected waters and in highly anoxic pore waters (Danielson et.al., 1992). Systematic trace element studies of other Paleoproterozoic phosphorites are needed to assess the underlying causes and the importance of hydrothermal processes of the Paleoproterozoic phosphogenesis.