Environmental settings of apatite precipitation in the Paleoproterozoic Pilgujärvi Sedimentary Formation

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The first significant P-rich deposits appear in the global rock record around 2 Ga ago in the Paleoproterozoic. This global phosphogenic episode has been linked to the Great Oxidation Event, the build-up of seawater sulfate or changes in the carbon cycle, but the exact mechanism for apatite precipitation remains under debate. In this contribution we study phosphorus-rich rocks from the ca 1.9 Ga old Pilgujärvi Sedimentary Formation, Pechenga Greenstone Belt, NW Russia. Apatite in these rocks occurs mostly in allochthonous sand-to-gravel sized clasts in gritstone/coarse-grained sandstone or as *in situ* layers in mudstone. Phosphate clasts can be subdivided into four petrographic types (A-D), each being represented by a distinct REE signature. Shapes of the phosphatic clasts range from elongated and angular to well rounded. Apatite can occur as massive aggregates with few impurities (type A) to submicrometer cystal-size apatite cement (type B) with abundant quartz and feldspar (type C) or pyrite (type D). Phosphorite layer discovered *in situ* in the Zapolarny quarry section consists of quartz and feldspar grains with massive apatite cement with varying abundance of pyrite, the latter of which giving it a slightly laminated structure. The *in situ* layer consists of parts petrographically similar to either type D or type C clasts in gritstone.

Petrographic and trace element characteristics suggest that the type D particles are the best preserved amongst the four types that show a negative Ce anomaly and positive Eu anomaly. REE signature from the *in situ* phosphorite layer shows features similar to both type C and D clasts. However, the analyses of *in situ* apatite show a positive Eu anomaly stronger than in any of the other clast types. Eu anomaly values in this layer increase gradually through the bed from 1.9 to 3.6. Also there is no negative Ce anomaly found in the *in situ* layer. This suggests that apatite was precipitated in changing conditions from oxic/sub-oxic to anoxic and under strong but varying hydrothermal influence.