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REE-activated cathodoluminescence of micro-apatites in glauconite: high resolution spectrometric analysis of CL emission

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Cathodoluminescence (CL) investigation combined with high resolution spectral analysis has shown a characteristic distribution of phosphatic material in sandstones of the shallow marine facies near Cretaceous shorelines in Westfalia (W Germany). It occurs in sand sized phosphorite and glaukonite nodules as well as in early diagenetic glauconitic cements.

The phosphate minerals occur as finely dispersed 5-20μm large crystallites within the glauconite nodules and glauconite cements, while the phosphorite nodules consist of microcrystalline apatite. They show characteristically a pale orange to pink or violet luminescence colour. In the CL-spectra, Dy^{3+}, Sm^{3+}, Tb^{3+} and Nd^{3+} have been found to be the most important activators, but Mn may also occur subordinately. The splitting of the multiplet level corresponds to the splitting of the energetic levels of the REEs in an apatite crystal lattice. Therefore, the phosphate mineral is suggested to belong to the apatite group. Early calcite and quartz cementation took place only after the formation of glauconitic cements so that the formation of glauconite / apatite at or near the sediment-seawater-interface is assumed in a slightly negative Eh (Fe^{2+} in glauconite and Mn^{2+} in apatite).

The emission lines of Sm^{3+} and Nd^{3+} are the predominant peaks in the CL-spectra of glauconitic nodules and cements indicating an enrichment of the light REEs compared to the intermediate and heavy REEs. The narrow bands of Dy^{3+} and Tb^{3+} occur subordinately. This distribution pattern is characteristic for rocks of the continental crust, e.g. granitoids, shales, and contrasts the REE-signature of the seawater which is de-

pleted in the LREE and enriched in the HREE. The REE has probably been transported absorbed to clay minerals and the P is suggested to originate from the organic material of the phytoplankton as well as from faecal pellets. The formation of the apatite and the enrichment took probably place during the earliest diagenesis.