Geophysical signal of the Beringhauser Tunnel section (Rhenish Massif, Germany): New insights for environmental reconstructions of Late Devonian events

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In marine sediments, magnetic susceptibility (MS) and gamma-ray spectrometry (GRS) measurements are frequently used to obtain information on change of fluxes and/or source of detrital inputs. MS signal integrates variable contributions of diamagnetic (calcite) minerals, paramagnetic (clays) matrix and ferromagnetic *s.l.* components residing generally in iron oxides whereas GRS signal yields concentrations of three elements: potassium linked to aluminosilicates (clays, micas), thorium, linked to clay and heavy minerals (zircon) and uranium associated to organic matter. Both signals could be affected by authigenic/diagenetic phases, which may prevent to a straightforward interpretation of their variations, more particularly in ancient sediments.

A detailed record of geophysical measurements (MS and GRS), have been performed from the Beringhauser Tunnel section (Rhenisch Massif, Germany) in order to determine the possible influence of authigenic/diagenetic phases and to bring new insights on the evolution of detrital input during the Late Devonian.

It clearly appears that K and Th concentrations show similar evolutions, i.e., an increasing trend during the middle of Frasnian following by a decreasing trend at the end of Frasnian, then a gradual increase at the base of Famennian and lastly a slight decrease during the middle of Famennian. The strong (r= 0.91) and positive correlation between K and Th argues for an admixture of fine-grained materials (essentially aluminosilicates), probably dominated by illite as indicated by the Th/K ratio always lower than 6. Unlike to K and Th, U signal is relatively stable and only marked by some noticeable peaks, which are also observed in the signal of the redox U/Th ratio. They are thus interpreted as episodes of O_2-depletion, three of them being linked to anoxic Lower and Upper Kellwasser Horizons and the Nehden Event.

By coupling MS measurements with hysteresis parameters, it appears that MS signal is mainly controlled by the ferromagnetic fraction. More precisely, hysteresis ratios suggest the coexistence of two ferromagnetic mineral phases: (1) a dominant fraction of low-coercivity magnetite grains and in a minor way (2) a fraction of high coercivity minerals (hematite). MS evolution is quite similar than those of K and Th concentrations, arguing for a detrital signature of both signals. In addition, three well-marked negative peaks of MS coeval with high U/Th ratios are also observed.

To summarize, both signals record evidence of a Late Frasnian period of detrital input changes marked by a positive peak following by two negative peaks in the levels corresponding to the Kellwasser-equivalent beds, whereas the base of the Famennian records an increase of detrital components. Then, the signals slightly decrease up to the middle of Famennian. This decrease of detrital input is perturbed by a noticeable short-term negative pulse corresponding to the Nehden Event.

The geophysical proxies indicate that the F-F boundary is marked in the Rhenish Massif by significant variations of detrital input, mainly recorded during the Kellwasser and the Nehden events. These changes are linked to sea-level rise likely associated to climatic evolution toward more humid conditions. Such environmental perturbations probably triggered increased continental weathering and the onset of O_2-depleted conditions.