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Rock magnetic evidence for the Plio-/Pleistocene palaeoclimatic change and for Pleistocene climatic cyclicity recorded in Upper Rhine Graben sediments

U. Hambach (1), C. Rolf (2) and M. Weidenfeller

(1) Chair of Geomorphology, University of Bayreuth, Germany, (2) Leibniz Institute for Applied Geosciences (GGA), Hannover, Germany, (3) Landesamt für Geologie und Bergbau Rheinland-Pfalz, Mainz, Germany (ulrich.hambach@uni-bayreuth.de)

Fluvial sediments provide valuable records of Pleistocene palaeoclimate. Especially large streams with an almost continent-wide catchment reflect sensitively the response of continental ecosystems to climate change. In the northern Upper Rhine Graben near Heidelberg, up to several hundreds of meters of fluvial clastics accumulated during the late Pliocene and Pleistocene. This regional depocenter is fed not only by material eroded in the nearby mountain ranges (Vosges, Black Forest) as well as by important regional tributaries (river Neckar), but essentially also by sediments from the alpine catchment of the Rhine. The onset of the alpine glaciation and the glacial history of the Alps are reflected by the composition of the sediments. The magnetic susceptibility (MS) variations with depth from two cores penetrating the infill of the depocenter reveal a cyclic pattern which resembles roughly the lithology. Sands and gravels show generally low values whereas MS is higher in silts and clays. The MS from the grain size fraction smaller than 200 micron of the sand and gravel beds is also increased relatively to the bulk sediment (all fractions smaller than 2 mm), indicating the dilution effect of the coarse grained diamagnetic silicates. At the base of the Pleistocene, a pronounced increase of MS can be observed which is caused by the higher contribution of alpine material containing more susceptible minerals. This increase is parallel to a sedimentological change from brownish/yellowish to greyish/greenish sediment colours. Rock magnetic investigations indicate Hematite/Goethite and magnetic iron sulphides as dominant magnetic minerals following this sedimentological change, respectively.

We interpret this rock magnetic and sedimentologic change as the response of the fluvial system to the globally observed climatic change at the base of the Pleistocene. The cyclic alternation of sedimentological high energy regimes (gravel and sands) on the one hand and low energy regimes (silt and clay) on the other hand is interpreted as a result of the cyclic alternation between glacial and interglacial climates during the Pleistocene. Interestingly, the fine sand fraction of the sand and gravel beds in the Pleistocene part of the section shows a stronger magnetic signal than the silts and clays. This observation is pointing to a climatically controlled increase of the alpine contribution to the sediment load of the Rhine. Ongoing rock magnetic and statistical investigation will hopefully improve our understanding of the relevance of the rock magnetic signal to the palaeoclimatic evolution of the Rhine system.