Glacio-isostatic induced changes of river courses and fluvial terraces in the South German Alpine Foreland?

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Introduction

The River Donau (Danube) and contributary rivers in Southern Germany show unexpected changes. So far explanations for diversions of the Donau argue on long term back cutting. But new datings by Optical Stimulated Luminescence (OSL) indicate that the diversions happened at the same time during a short period in the early part of the last glacial cycle. It appears unlikely that local back cutting results in contemporaneous river diversions. Glacial rebound is here discussed as an alternative explanation.

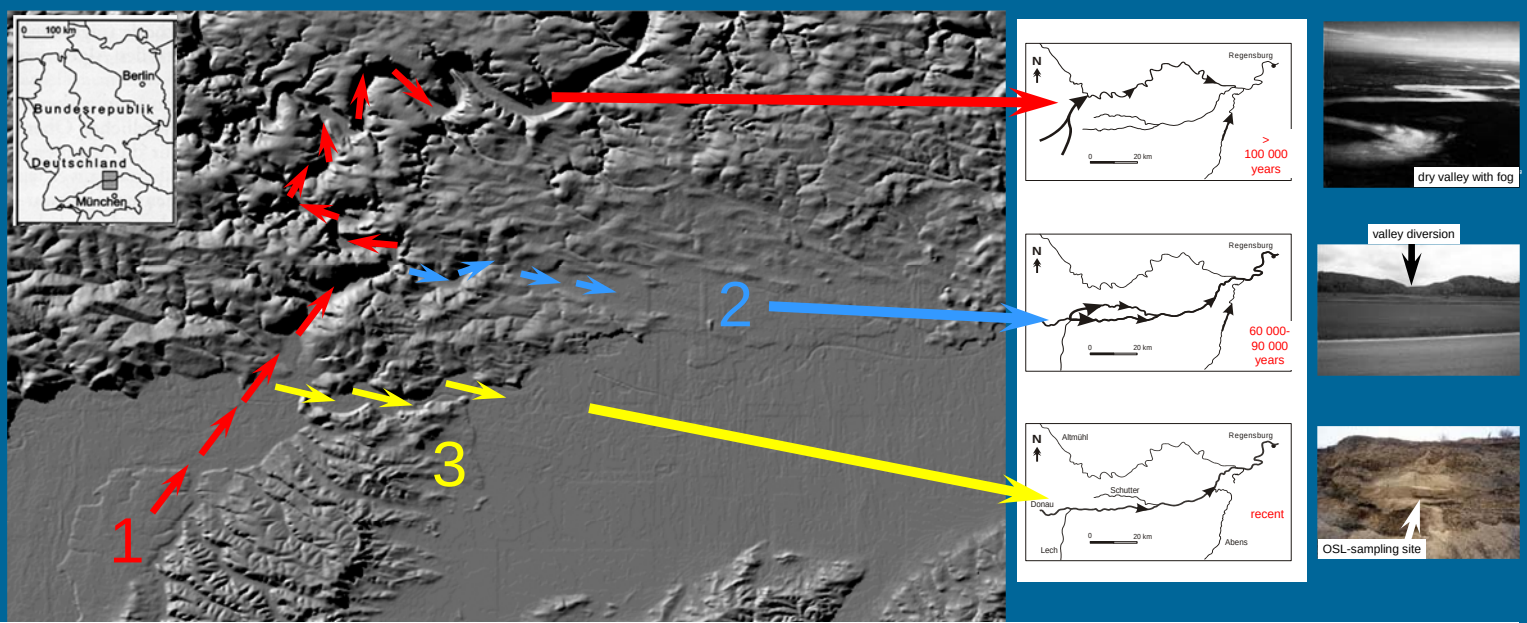


Fig.1: The present River Donau in Southern Germany flows West-East (yellow arrows) along the southern boundary of the Franconian Alb. More then 100 000 years ago the Donau used a presently dry valley (see picture with fog) incised in Jurassic bedrock of the Franconian Alb (red arrows). Later the course changed into another valley in the southern most part of the Franconian Jura (blue arrows). New results of OSL-dating reveal that all flows pathes were deposited between 90 000 and 60 000 yr ago, thus during the early part of the Last Glacial Cycle (Fiebig & Preusser 2003, Z. Geomorph. N.F. 47(4): 449-467). The gravel accumulation of the Rainer Hochterrasse (1) (terrace border is visible in the shaded digital elevation model) is connected in altitude with fluvial sediments in the dry valley (OSL-age: 75-84 +/- 7 ka). The terrace accumulation of the Ingolstädter Hochterrasse (2) consist of Alpine Donau-gravels which were transported through the small adjacent valley (OSL-age: 67-75 +/- 11 ka). The gravel accumulation of the Neuburger Hochterrasse (3) along the recent course of the Donau dates to an OSL-age of 78 +/- 8 ka. What caused these river courses of the Donau at the border of the Franconian Alb during the first part of the last glaciation?

A glacio-isostatic model

Fig. 2: Ice load during the Last Glacial Maximum (LGM) in the Eastern Alps (Fiebig et al. 2004 IN: Ehlers & Gibbard: Quaternary Glaciations – Extent and Chronology).

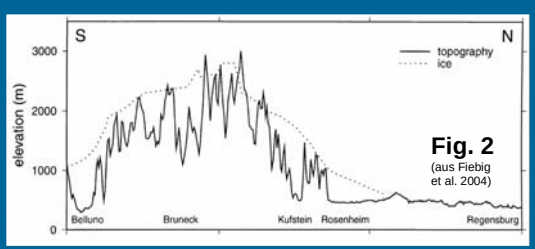
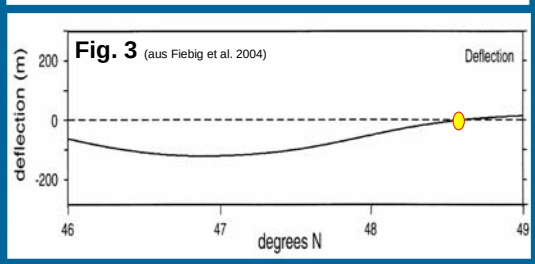


Fig. 3: Potential for glacio-isostatic movements of the crust below the ice load. Based on these calculations subsidence merges into uplift in the area of the Franconian Alb (see yellow dot).



A new explanation for the Donau diversions is suggested on the base of these calculations: the uplift could have caused the abandonment of the northern most (afterwards dry) valley in the Franconian Alb. After this first diversion to the south a second diversion to the border of the Franconian Alb was induced by the same movements. Other rivers in the area show unexpected phenomena as well: eg. delta deposits at a water divide position in the Abens valley during the penultimate glaciation, and stacking of fluvioglacial gravels spreads during the early part and the maximum of the last glaciation in the Lech and the Abens valley.

Conclusion

A reason for unexpected behaviour of rivers in the Franconian Albs is suggested. Ice load in the Eastern Alps and deflection of the crust could have induced delta accumulations in a watershed position in the Franconian Alb as well as repeated rivers diversions into southern direction and gravel sheet stacking. Possibly not only the amount of ice but as well the duration of the load could have influence the changes. For example, the diversions of the Donau during the early part of the last glaciation could be a consequence of a long impact of a comparatively small ice load in the Eastern Alps. To verify these glacio-isostatic ideas more studies and calculations with good age control are necessary.