Seismic facies changes and flower structures : indicators for significant lateral block movements within the Swiss Molasse Basin

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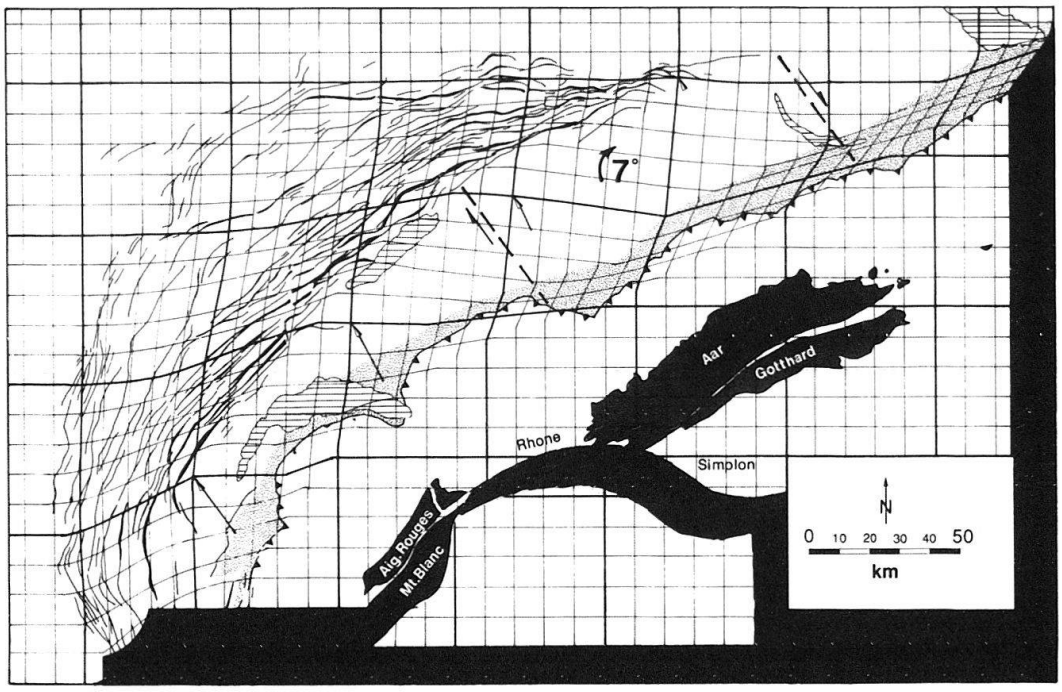

Fig. 2. New model for the large-scale Miocene deformation of the northwestern mountain front of the Swiss Alps. Deformation is visualized through the present day, deformed state of an initially rectangular Miocene coordiante grid with 10 km spacing. Fold trends (anticlines) in the Jura fold and thrust belt are copied from Heim 1921, plate XX. (From Burkhard 1990).

Seismic facies changes and Flower Structures – indicators for significant lateral block movements within the Swiss Molasse Basin

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Seismic sequences within the Middle and Lower Mesozoic interval below the Molasse Basin of northeast central Switzerland tend to thin out in a southerly or easterly direction. Within individual wedge-shaped sequences, defined by unconformities and regionally consistent reflectors, the seismic facies changes laterally in a more or less consistent way.

On long regional seismic dip lines it is often possible to laterally distinguish a typically northern from a typically southern seismic facies within a particular seismostratigraphic unit. However, locally the seismic interpreter is puzzled by difficulties of correlating seismic sequences and events across faults, particularly when both thickness and facies of some units seem to change abruptly. Such changes across faults were originally regarded as a serious nuisance to seismic interpretation in an area with a relatively wide and irregular grid of lines of different vintage and differing processing, lines that moreover often cut faults at random, or worse, at acute angles.

Meanwhile, abrupt changes across faults have turned into useful information, welcomed as clues to interpret the tectonic history of the area: Post-Mesozoic block movements along strike-slip faults are the most likely explanation for abrupt changes of facies and thickness across faults below the Molasse Basin.

The amount of lateral movement along strike-slip faults must be considerable to become expressed in terms of thickness and facies of seismostratigraphic units, although giving any figures is still a matter of speculation.

The view of significant post-Mesozoic lateral block movements is strengthened by the observation of additional phenomena, regarded as typical expressions of wrench faulting, such as positive and negative flower structures, interpreted from seismic. The evidence of extensive fault and fracture zones in a well drilled by Nagra into the basement below a flower structure at Schafisheim, is a strong indication for the significance of fault systems below the Molasse Basin of northeastern and central Switzerland, interpreted as being related to lateral block movements.

Wrench faults underneath the northeastern Swiss Molasse Basin seem to have been strongly influenced by the tectonic heritage of the area. There are indications that movements went on repeatedly, some of them originating in the Paleozoic and rejuvenated episodically up to geologically recent times.

Seismoactive fault systems in the basement and sedimentary cover of the Swiss Plateau and the Jura Mountains

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Introduction

Detailed investigations of local and regional seismic activity have been performed during the last decade in northern Switzerland. These studies were made possible by the completion of the network of permanent seismic stations of the Swiss Seismological Service (SSS) and the installation of local temporary seismic networks (s. SSS, Montly Seismic Bulletins, Annual Reports). The increased density of seismic station distribution allowed an improved location of local small events and the construction of a large number of well-constrained fault-plane solutions and station diagrams.

Precise relative location of earthquakes

A characteristic feature of the seismicity of Switzerland is the occurrence of many earthquakes in clusters or swarms. The individual events of a particular swarm exhibit almost identical signal forms, and evidently correspond to repeated slip on the same