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The Earth's Crust under the Swiss Molasse Basin

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The seismic structure of the Earth's crust in Switzerland has been investigated over the past 20 years by seismic refraction and reflection methods (Mueller et al. 1980, Frei et al. 1990, ETH Working Group on Deep Seismic Profiling 1991). These surveys have mostly been restricted to areas outside the Molasse Basin because of the high noise level of civilization, environmental problems associated with large explosions, and logistic difficulties caused by the dense population. A list of references is given below. Relevant measurements for the basin comprise, in the north and northwest, crustal refraction/wide-angle reflection profiles along the folded Jura (Egloff 1979), detailed refraction and reflection surveys connected with Nagra reconnaissance in northern Switzerland (Finckh et al. 1986, Sierro 1988), and short southward extensions of investigations in the southern Black Forest (Gajewski & Prodehl 1987, Gajewski et al. 1987). The southern margin of the Molasse Basin was surveyed by a profile parallel to the strike of the Helvetic nappes from the Jaunpass to the Säntis in 1987 (Maurer & Ansorge 1992) connecting the eastern and western traverses of the Swiss National Research Project NFP20. The refraction seismic profile of the European Geotraverse (EGT) crosses the northeastern part of the Swiss Molasse Basin and provides the only continuous information about the deep crustal structure (Ye 1992, Aichroth et al. 1992). The northern end of the near-vertical reflection survey along the eastern NFP20 traverse does not touch the Molasse Basin and contains only very limited information about the lower crust from the migrated data (Holliger & Kissling 1991, Valasek 1992). Stäuble & Pfiffner (1991) have reprocessed the only available shallow line of reflection profiles of 4 s TWT across the Molasse Basin from the Subalpine Molasse to Stein am Rhein.

Careful relocation of earthquakes below the central and eastern Molasse Basin has led to maximum P-wave velocities for the lower crust, which supplement the sparse velocity data from active surveys mentioned above (Pfister 1990, Deichmann 1992). Much more abundant seismic crustal data beneath the Molasse Basin are available outside of Switzerland. In the southwest the ECORS reflection profile ALP2-86 traverses the Molasse from the Plateau Glières in the Chaines Subalpines across the Salève to the Jura Mountains northeast of Bellegarde as an extension of the ECORS CROP transect through the western Alps (Sénéchal & Thouvenot 1991). In the northeast a number of older refraction and reflection surveys in the German Molasse Basin between Lake Constance and Augsburg provide information about the crustal structure (Mueller et al. 1987).

The main structural features of the crust beneath the Swiss Molasse Basin north of the Helvetic overthrust derived from these sparse data are:

- The pronounced velocity variation in the upper and lower crust found further north under the Black Forest and Swabian Jura disappear towards the south.
- The highest velocity in the lower crust is 6.35 km/s beneath the Molasse Basin.
- The thickness of the highly reflective lower crust observed under the Black Forest decreases and the reflectivity diminishes towards the Jura and further south under the Molasse Basin to resemble the well-known pattern of the NFP20 traverses. The same is observed at the transition from the Jura to the Molasse Basin on the French profile ALP2.
- The Moho deepens from 28 km under the southern foothills of the Jura to 34 km under the northern margin of the Alps.

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