The subsurface structure of the Osterhorn Mountains: How to create a large-scale flat-lying nappe complex in a mountain belt?

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Fold-and-thrust belts form within a variety of structural settings in terms of their geometry, basement architecture and nappe thickness. Most of them are showing a classical anticlinal and synclinal structure, with a distinct pattern of thrust faults. Major portions of virtually undeformed flat-lying nappes are rare in mountain belts and would need, as a conceptual model, very special conditions for its formation in contrast to classical thin-skinned fold-thrust belts.

The Osterhorn Mountains within the Northern Calcareous Alps represent an example for such a flat-lying structure. It shows a largely subhorizontal and undisturbed bedding of the Triassic and Jurassic limestone formations and thus represents a special feature within the highly folded and imbricated Northern Calcareous Alps. Due to its geological structure, the Osterhorn Mts. were an area of intense seismic exploration of OMV AG in the late Seventies and early Eighties of the last century with the goal to find potential oil traps and reservoirs along the migration routes at the base of the alpine nappe units. The exploration campaign gathered a dense network of seismic profiles in the area of the Osterhorn Mts., which reaches a depth of more than 10,000 meters and provides an insight down to the autochthonous basement and autochthonous Cenozoic Molasse cover overridden by the alpine nappe stack.

In our study we assume a causal link between the subhorizontal bedding of the Osterhorn-Tirolic nappe and the underlying Bajuvaric nappe as well as the autochthonous and thrusted allochtonous Molasse basin. On the basis of the seismic data, we create a conceptual three-dimensional underground model to figure out the deep structure of the Osterhorn Tirolic-nappe and the subjacent formations. The interpretation of the area between the Bajuvaric nappe and the crystalline basement is considered as a key zone in the structural geological development of the Osterhorn Mountains. As a result of the proximity of these layers to the décollement of the Alpidic thrust unit, the assignment of the seismic structures to a realistic geological bedrock model requires a complex interpretative work. This three-dimensional model is used to determine the special conditions for the subhorizontal bedding like a stiff undeformable backbone, an extremely weak zone of shearing at the base of the thrust sheet and potentially a subhorizontal underground.