The central Styrian Basin (Gnas Subbasin): Structure and stratigraphy revealed by seismic and borehole data

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The Gnas Subbasin represents the central part of the Neogene Styrian Basin in the southeast of Austria. Despite decades of exploration activity for hydrocarbons, the formation mechanisms and the basin architecture are still poorly understood. To increase our understanding, seismic lines and well data, provided generously by RAG Austria AG and OMV were re-interpreted. The subsurface data gives new insight into basin depth and geometry, tectonic patterns and the stratigraphy of the Neogene basin fill. For instance, seismic data reveals that the basin depth exceeds 4 km below ground level. Seismic interpretation further allowed to reconstruct the tectonic evolution of the basin. Basin evolution was initiated by extreme crustal extension in the lower Miocene, activating a detachment horizon within the pre-Neogene basement. Synsedimentary low angle normal faults, arranged in a radial, most likely en-echelon pattern around the basin centre, dissected the hanging wall of the detachment into fault blocks, resulting in a pronounced relief of the pre-Neogene basement. Consequently, coarse-grained sediments were deposited in alluvial fans and fan delta complexes in early Miocene time. Furthermore, seismic data show that the Carpathian synrift deposits cover significant parts of the subsurface of the Gnas Subbasin and reach a thickness of at least 2 km in the depocenter of the basin. Major fault activity ceased around the Carpathian/Badenian boundary (i.e., Styrian Tectonic Phase). The up to 1,200 m thick Badenian succession is characterized by turbidite deposits and lower Badenian lava flows in central parts of the subbasin. On isolated highs, in contrast, lower and middle Badenian Leitha Limestone formed. The Sarmatian succession is characterized by a merging of the various depositional environments into a unified, shallow marine environment. The thickness of Sarmatian strata is up to 800 m. The Sarmatian can be described by a 3rd order sequence which further subdivides into five 4th order sequences. The Pannonian succession is characterized by a uniform, fluvial-limnic-deltaic depositional environment. Post-Pannonian compression resulted in crustal-scale folding and significant uplift along the basin margins. In contrast, inversion of faults cannot be observed in seismic data.