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TECTONIC INVESTIGATION STRATEGIES FOR THE PLANNING OF THE BRENNER BASE TUNNEL

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The 55 km long Brenner Base Tunnel between Innsbruck and Franzensfeste is part of the European high capacity rail corridor from Munich to Verona. The tunnel crosses the main chain of the Eastern Alps and transects the entire Tauern Window below the Brenner detachment fault and adjacent Austroalpine and Southalpine Units. Proceeding from North to South, the corridor passes through or close to major Tertiary orogen-scale fault systems such as the Inntal Fault Zone, major faults at the northern border of the Tauern Window, the Brenner Detachment Fault, the Periadriatic fault system and several other, previously unknown faults within the Tauern Window and the South Alpine Units. Due to the possible unfavourable rock mechanic and hydrogeological properties of fault rocks zones such as the ones mentioned above form major risk zones for tunnelling.

Initial planning for the Brenner Base Tunnel includes detailed investigations on tectonics and structural geology accounting for the prime importance of tectonic structures. The ongoing investigations have been scheduled to (1) support geological mapping in the construction of well-constrained sections and extrapolated depth-maps at the level of the tunnel; (2) pinpoint, map and characterise major tectonic faults in the corridor of investigation; (3) provide semi-quantitative estimates of joint and fracture systems for subsequent rock quality assessment; (4) assess hazards imposed by active tectonic processes and earthquakes; and combine all information into a "tectonic hazard map", which supports further planning including the selection of the alignment of the tunnel within the present area of investigation.

The challenge of mapping a tectonically very complex corridor of some 550 km^2 in high Alpine regions within very short time enforced by the tight schedule of the Brenner Base Tunnel Company was met by the integration of geological, remote sensing, DEM, and "traditional" structural geology-data in a GIS. The investigation strategy uses a four step approach starting from the evaluation of existing data and a desk-top mapping of possible faults ("tectonic lineaments"), which was done by the integrated interpretation of geological maps, remote sensing (Landsat 7), and topographical data (DEM) using GIS-compatible digital image processing tools (step 1). The results were used for the efficient planning of field surveys carried out as step 2 in order to obtain structural and kinematic data from microtectonic outcrop analyses (ductile and brittle structural analyses) and to map major faults in the field. Field work also included the mapping of mass movements and the ground control of the interpretation of step 1. In a third part, the resulting structural and kinematic data were integrated into a regional structural model and deformational sequences for the individual major tectonic units (step 3). In order to account for their importance in tunnelling we strongly focused on the analysis of brittle structures. Step 4 includes the construction of a regional tectonic map considering mapping results and the re-interpretation of the

data processed in step 1. By this procedure remote sensing and DEM-data are used to extrapolate spatially limited outcrop or mapping information to the whole area of interest. Field data are stored in a database which is linked to the GIS system. Finally all structural data of relevance to the project were attributed, weighted and superimposed in a grid-based approach to produce a map which shows in an entirely abstract way zones which are favourable or non-favourable for the project.

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