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Structural geological models: Essential information for civil engineering works. - Tapovan HEPP, Himalaya, India

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The investigation area is situated in the Indian Himalaya south of the junction of Dhauliganga and Alaknanda River at Joshimath between Shelang and Tapovan. The alignment of a ca. 12 km long head race tunnel passes through metamorphic rocks of the Joshimath and the Helong Formation, part of the Higher and Lesser Himalayan units, respectively. Severe geotechnical problems during tunnel excavation resulted in a review of the predicted geological model (tender model). The findings of the review show that the actual geological conditions deviate substantially from the predicted geological model. Tectonic and structural geological issues were neglected in the predicted model (Fig. 1). An improved structural model was required within short notice as excavation works were ongoing.

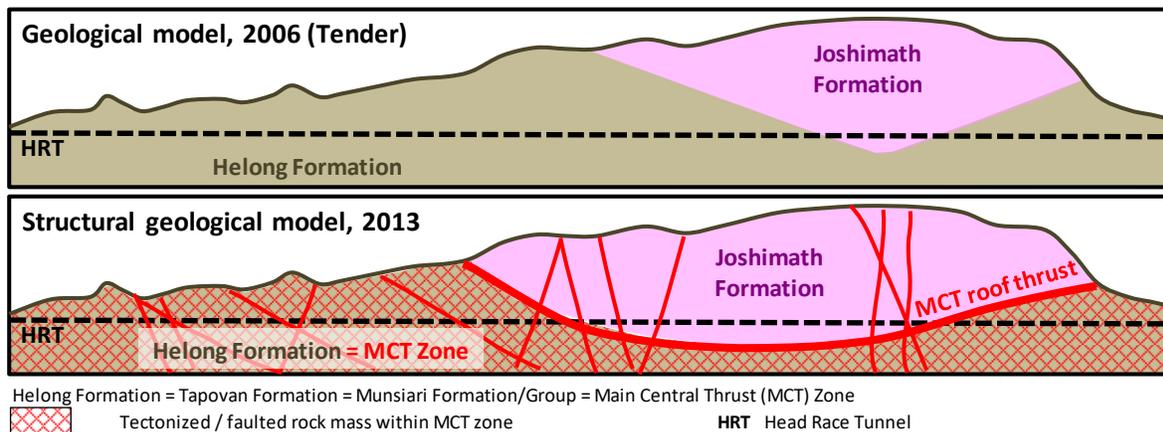


Figure 1: Development of the revised structural geological model along the head race tunnel

The geotechnical behaviour is dominated by (semi)brittle structures and their characteristics. Two basic types of brittle tectonic features were identified. Low-angle features, including the foliation and low-angle shear planes, which were originally formed by ductile shearing along the Main Central Thrust zone (MCT). Medium- to high-angle features were created by younger, brittle deformation.

One of the major issues with significant implications for the tectonic model along the tunnel alignment is the allocation of the roof thrust of the MCT, which was stated to pass south of the project area. In contrast to the prediction, excavation data, field data as well as various scientific papers [1, 2] show that most of the tunnel passes through the tectonized MCT below the Vaikrita Thrust. To confirm the field evidence concerning the position of the Vaikrita Thrust, metamorphic-petrological studies (geothermobarometry and microstructural analyses) on samples collected along the headrace tunnel were performed. Results of the petrological study mesh well with the conclusions published by Sati [2]

and Spencer et al. [3], which report and prove a discordance and inversion in metamorphic grade between the Helong and the Joshimath Formations, implying the presence of a thrust zone at the base of the Joshimath Formation.

References:

[1] Ahmad T et al. (2000) GSA Bulletin 112(3): 467-477

[2] Sati D C (1988) In: *Garwhal University, Srinagar, India (unpublished PhD Thesis)*

[3] Spencer C J et al. (2012) Tectonics 31: TC 1007

