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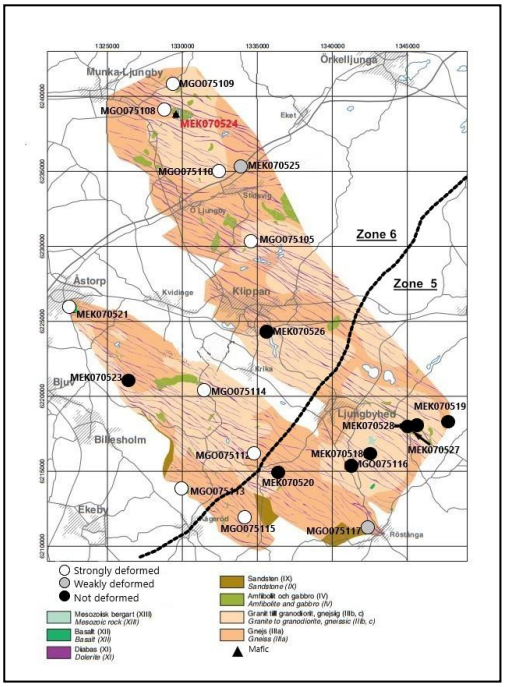
Crushed bedrock aggregates for highway construction in Sweden; under which conditions?

Sweden has a strong economy, which invests billions of SEK in transport infrastructure. The improvement and expansion of the road and railway network is of high importance. However, the sand and gravel that were used so far as aggregates in construction are finite, and they must be preserved because they act as aquifers. The usage of crushed bedrock as aggregate is promising, but there are some specific conditions related to mineralogy, grain size and deformation, that should be taken into account.

The study area is located in southwest Sweden, in Skåne region. These Precambrian rocks were metamorphosed during the Sveconorwegian Orogeny and they are mostly metamorphic gneisses with igneous protolith. Their main mineralogy includes quartz, feldspars, biotite, amphiboles and secondary alterations, together with accessory phases. Due to the metamorphic conditions of high pressure and high temperature, they are deformed and this deformation is visible under microscope, as the minerals in most of the samples studied are elongated. The samples in that are located in the north and northwestern part of the study area have been subjected to higher metamorphic conditions than the ones in the southeastern part, and they are more fine-grained and more deformed. This difference plays a major role in their technical quality.



More specifically, the samples that are in the northern part appear to have very good technical properties, and they are ideal for road and railway construction. They have higher amount of quartz and less feldspars. The amount of fine-grained minerals is quite higher than the other samples, and they are generally more deformed. The grains are elongated but their complexity is medium, in comparison to the samples in the southeastern part; there, they are less deformed, the grain size is higher, but the grains are more irregular. These samples also have lower amount of quartz and higher amount of feldspars. The presence of quartz is crucial, because of its high hardness, increasing the rock's strength.

Aftermath?

The degree of deformation is an important factor to the technical quality of the samples in order to be used as aggregates. The more deformed a rock is, the lower is the grain size in our study area. Since he technical quality of the samples increases with lower grain size, the deformation is a good factor. However, the high complexity of the grains results in better interlocking of the grains, but in our samples the rocks that have more irregular grains are the ones with lower quality. Here comes the critical question; which one is the most important factor? The answer in our case is grain size. Of course, the mineralogy is important, but since all of the samples are similar in composition, the textural differences make the difference.

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(Figure: The study area located in Söderåsen, NW Skåne. The samples are coded in relation to their degree of deformation, and the boundary represents the metamorphic zones 5, 6 after Möller & Andersson, 2018. The samples in zone 6 show higher metamorphic conditions and better technical quality).