



Calcite sinter formation in alkaline drainage solutions of tunnel buildings – chemical evolution and distribution of $^{13}\text{C}/^{12}\text{C}$ and $^{18}\text{O}/^{16}\text{O}$ isotopes

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The drainage systems of several tunnels in Austria and Germany are heavily clogged by calcite precipitates. Calcite sinter in drainage systems may induce serious problems due to the reduction of cross sections of drainage tubes and the pollution of receiving streams by suspended calcite and ongoing sinter formation. The formation of alkaline environments is mostly related to the dissolution of portlandite ($\text{Ca}(\text{OH})_2$) in contact with the concrete. In this situation highly alkaline calcium hydroxide solutions are obtained.

In general, calcite-sinter is related to dissolved inorganic carbon of ground waters. Nevertheless, great quantities of sinter may also occur in tunnels where ground waters are low in dissolved carbonate (e.g. in areas dominated by sandstone or shale). Moreover, precipitation of calcite continues also in those ground waters generated in carbonate rich areas, although the primary dissolved carbonate is already lost. This may suggest an influence of atmospheric CO_2 . Gaseous carbon dioxide is absorbed into the solution and thus contributes to further precipitation of calcite. The results show, that both mechanisms, precipitation of carbonate from ground water and absorption of atmospheric CO_2 , may be deciphered by the stable isotopic composition of carbon and oxygen in the precipitated calcite. In general, solid CaCO_3 obtained by atmospheric CO_2 -absorption has a $\delta^{13}\text{C}$ -value of about -25‰ (PDB), whereas precipitation of CaCO_3 from ground water carbonate implies the characteristic isotopic signature $\delta^{13}\text{C} \approx -13\text{‰}$ (PDB).