

Hydrotalcite and quintinite from Dypingdal, Snarum, Buskerud, Norway

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Introduction

The new mineral species hydrotalcite was described by Hochstetter (1842) from Snarum. There is no doubt that the type locality must be the Dypingdal serpentine-magnesite deposit. A sample of the mineral had been presented by Prof. Scheerer to Dr Marchand, who gave it to Hochstetter for investigation. The chemical analysis performed by Hochstetter shows that the mineral is essentially a hydrated carbonate of magnesium and aluminium. It was associated with "steatite" which is usually regarded as a synonym of talc, $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$. However, the chemical analysis of Hochstetter (1842) shows an appreciable amount of Al_2O_3 (12.52 wt%).

Hochstetter's analysis of hydrotalcite gives an $\text{Mg}:(\text{Al}+\text{Fe}^{3+})$ ratio of 2.80:1.00. Its Fe_2O_3 content of 6.90 wt% is suspiciously high and might indicate contamination by an iron-rich mineral. An extensive older literature exists on hydrotalcite, discussing whether it should be regarded as a distinct mineral or a mixture, and is summarized by Frondel (1941). The validity of hydrotalcite as a species was shown by Manasse (1915), who obtained the chemical formula $\text{Mg}_6\text{Al}_2\text{CO}_3(\text{OH})_{16}\cdot 4\text{H}_2\text{O}$, with $\text{Mg}:\text{Al} = 3:1$. The trigonal crystal structure of hydrotalcite was first determined by Allmann & Jepsen (1969).

Fron del (1941) described manasseite as a hexagonal polytype of hydrotalcite from Snarum and from Amity, New York. Hydrotalcite and manasseite are frequently intergrown in the Dypingdal deposit and are almost indistinguishable in appearance (Neumann 1985). The nomenclature of the hydrotalcite supergroup has recently been reviewed by Mills et al. (2012). According to IMA rules, polytypes are not to be regarded as distinct species. Therefore, the name manasseite is discredited. The original hydrotalcite is hydrotalcite-3R, and manasseite becomes hydrotalcite-2H.

Hydrotalcite belongs to a large group of naturally occurring and synthetic *layered double hydroxide* (LDH) compounds (Mills et al. 2012). Their structures are derived from that of brucite, $\text{Mg}(\text{OH})_2$, in which edge-sharing $\text{Mg}(\text{OH})_6$ octahedra form continuous sheets parallel to (001), linked by relatively weak hydrogen bonds. In the LDH compounds, the brucite-like layers contain both divalent and trivalent cations, creating a surplus positive charge that is balanced by interlayer anions, coupled with additional water molecules. In the case of hydrotalcite, carbonate (CO_3^{2-}) is the interlayer anion. According to Mills et al. (2012), the formula $\text{Mg}_6\text{Al}_2(\text{OH})_{16}[\text{CO}_3]\cdot 4\text{H}_2\text{O}$ is recommended for hydrotalcite, with the interlayer anion shown in square brackets. The first part of the formula, $\text{Mg}_6\text{Al}_2(\text{OH})_{16}$, indicates the composition of the brucite-like layer. The water molecules and interlayer anions are intercalated between two brucite-like layers, hence the designation 'layered double hydroxide'.

On the track of quintinite

In 1986, I published the results of reconnaissance electron microprobe analyses of four hydrotalcite samples from Dypingdal (Raade 1986). The mean analytical results of $\text{Mg}:(\text{Al}+\text{Fe})$ ratios were, with numbers of individual analyses in parentheses: 2.80:1 (1),

2.30:1 (2), 1.95:1 (4) and 1.92:1 (3). Only the first sample has a ratio close to the ideal 3:1 in hydrotalcite. The two last samples have a ratio close to 2:1, and the second sample lies in between. I did not pay much attention to these results at the time, knowing that synthetic phases with equivalent structures had been shown to possess highly variable $\text{Me}^{2+}:\text{Me}^{3+}$ ratios (Allmann 1970), and structure determination of alleged hydrotalcite from Moravia had given the formula $\text{Mg}_4\text{Al}_2\text{CO}_3(\text{OH})_{12}\cdot 3\text{H}_2\text{O}$ (Allmann & Jepsen 1969).

A specimen of hydrotalcite from Snarum was studied in detail by wet-chemical analysis and X-ray powder diffractometry by Stanimirova (2001). Three morphological varieties were distinguished macroscopically, based on differences in colour, transparency, lustre and nature of the aggregates. Samples HT-1 and HT-2 have Mg:Al ratios of 2:1, whereas for sample HT-3 the ratio is 2.30:1. The X-ray powder data of sample HT-1 were indexed on a $2H$ manasseite cell. For sample HT-2, the X-ray data are interpreted as a mixture of $2H$, $3R$ and $6R$ polytypes. Sample HT-3 is predominantly a $3R$ polytype, with a small amount of the $6R$ polytype.

In 1997, a hydrotalcite-like mineral with composition $\text{Mg}_4\text{Al}_2\text{CO}_3(\text{OH})_{12}\cdot 3\text{H}_2\text{O}$ was described as the new species quintinite, occurring as $2H$ and $3T$ polytypes (Chao & Gault 1997). Quintinite- $2H$ was found in the Jacupiranga mine, Brazil, and quintinite- $3T$ at Mont Saint-Hilaire, Canada. When that paper appeared, I regrettably failed to couple the new mineral with my previous, 11 year old results on the composition of Dypingdal hydrotalcite. Being closer in time, it may seem strange that Stanimirova did not recognize the identity of her mineral with quintinite. It was only in 2012, when we had the hydrotalcite supergroup nomenclature for approval in the Commission on New Minerals, Nomenclature and Classification, that it became clear to me that quintinite occurs at the Dypingdal locality. Thanks to my comments, this is mentioned in the paper by Mills et al. (2012), and the reference to Stanimirova (2001) was added.

The cases with Mg:Al close to 2.30:1, observed by both Raade (1986) and Stanimirova (2001), suggest intergrowths of hydrotalcite and quintinite.

Coda

It is remarkable that two independent investigations on randomly chosen hydrotalcite samples from Dypingdal, by Raade (1986) and Stanimirova (2001), have resulted in several cases where the formula corresponds to that of quintinite, $\text{Mg}_4\text{Al}_2(\text{OH})_{12}[\text{CO}_3]\cdot 3\text{H}_2\text{O}$. This is a strong indication that quintinite may be widespread at the locality. It seems at the moment that the two minerals are not easily distinguished macroscopically. From the classical Dypingdal deposit, samples of 'hydrotalcite' are spread all over the world in mineral museums and private collections. The question is: what is it that you have in your collection, is it hydrotalcite or quintinite?

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