

## Corrensite of Deuteric Origin

WILLIAM J. FURBISH

*Department of Geology, Duke University  
Durham, North Carolina 27708*

### Abstract

Corrensite occurs as the result of deuteric action in a sill-like gabbro body near Durham, North Carolina. It forms both as a replacement product of chlorite in chlorite-prehnite or chlorite-laumontite alternation zones in the gabbro and as a hydrothermal fracture filling.

The occurrence of corrensite outside a sedimentary or weathering environment has been reported only three times. Two of these were intergrowths with asbestos, the other with talc.

### Introduction

Most occurrences of corrensite (a trioctahedral, ordered 1:1 chlorite-vermiculite; Peterson, 1961), have been reported in sedimentary environments. Kopp and Fallis (1974), Lippman and Savascin (1969), Fournier (1961), Grim, Droste, and Bradley (1960), Braitsch (1960), and Lippman (1956) report corrensite associated with evaporite sequences. Peterson (1961), Echle (1961), Bradley and Weaver (1956), and Earley *et al* (1956) have reported corrensite associated with more typical carbonate sequences. Johnson (1964) reported corrensite formed from chlorite by surface weathering processes.

Gradusov (1969, 1967) described corrensite intimately associated with talc, anthophyllite, and chrysotile in the Zerevta asbestos deposits of the southern Urals and from asbestos rock of the Bugety-Say. Allietti (1958) found it in a talc-serpentine mass from the Toro Valley of Italy. The present paper records the formation of corrensite by hydrothermal processes in open fractures of a deuterically-altered sill-like, gabbro body.

### Description and Data

Deuteric alteration along a late fracture system in the gabbro has changed the host rock adjacent to the fractures predominantly to chlorite-prehnite or to chlorite-laumontite. The resultant fluids have then, contemporaneously or subsequently, deposited a group of Ca-Mg-Na-Al-Si-bearing minerals along and within the fracture. Corrensite, one of these minerals, occurs as a replacement product of chlorite and as a hydrothermal vein filling.

The fracture system occurs at the junction of a

northeast-striking, vertical feeder dike with its northwest-trending lateral sill expression. The fractures trend parallel to the strike of the dike and are nearly vertical. Evidence of movement is shown by the presence of slickensides. The fractures do not pass into the overlying Triassic sediment but are contained wholly within the basic body.

Deuteric alteration along the fractures is most pronounced where they cross coarse-grained or pegmatitic facies of the gabbroic host material and the alteration zone may be as much as one meter wide on either side of the fracture. Where cross fracturing or movement on undulating surfaces occurs, openings are formed. It is in these openings that the hydrothermal mineral deposition takes place.

When corrensite forms as an alteration product of chlorite, it is interleaved with the chlorite and grades to more pure corrensite toward the center of the fracture. Replacement textures are present in these circumstances.

Where corrensite is deposited by hydrothermal solution in an opening, one of three genetic sequences is followed. It progresses from the alteration of chlorite to solution-deposited material; it follows gyrolite in the sequence chlorite-prehnite → gyrolite → corrensite; or it fills an opening in a laumontite-chlorite alteration zone. In all cases the end product is corrensite coprecipitated with (included) crystalline prehnite spheres.

The color of the corrensite ranges from pale green to gray-white. It appears green when interleaved with chlorite, gray-white when pure and foliated, or light-green when pure and massive.

Corrensite was identified by the methods outlined

by Bradley and Weaver (1956), Peterson (1961), and Warshaw and Roy (1961), using X-ray data from untreated, heat treated, glycolated, and Mg-saturated samples. Data obtained did not indicate a difference between corrensite formed by replacement of chlorite and that deposited by hydrothermal solution.

### Discussion

A survey of the literature points out certain recurring associations and patterns under which corrensite is found. A few selected references will be given for illustration.

By far the greatest number of reported occurrences of corrensite are those existing in evaporite sequences. In these, corrensite appears to form as an authigenic mineral (Kopp and Fallis, 1974) or as a reaction of chlorite or micaceous minerals with a solution (Lippman and Savascin, 1969).

Corrensite is also often reported to exist in other sedimentary sequences which typically contain carbonates. Peterson (1961) describes the mineral as authigenic and reports its occurrence in a carbonate sequence containing some dolomite. Bradley and Weaver (1956) report corrensite formed from chlorite by water and exchange bases in a limestone.

Johnson (1964) reports corrensite as the product of surface weathering processes in which the chlorite of greenstone changes to corrensite by leaching. The formation of corrensite in an asbestos deposit is reported by Gradusov (1967) as the product of a chlorite-to-corrensite conversion. This paper reports the formation of corrensite by hydrothermal solutions both as the product of replacement of chlorite and as a vein filling.

Therefore, regardless of the host material, the pattern that emerges is that corrensite forms either by replacement of a micaceous mineral or by direct precipitation from solutions. Further, the composition of the solution appears to be an important factor.

Lippman (1956) considered corrensite to be a provenance mineral formed through the depletion of chlorite, although he first postulated it to be an indicator of a saline environment. Later, Lippman and Savascin (1969) found corrensite as the predominant clay mineral in gypsum and related its formation to the reaction on mica of a solution rich in magnesium. Bradley and Weaver (1956) attributed the formation of corrensite in the Brazer limestone to the action of water and exchange bases on chlorite.

Becher (1964/65) observed both chlorite and corrensite in a sequence of clay minerals distributed

from border to center of a Triassic, sedimentary basin in Bavaria. The sequence was independent of the heavy mineral suite pattern, which reflected provenance. He, therefore, concluded that the clay sequence was the result of the environment of sedimentation and was heavily dependent upon the basin configuration and its solution chemistry during deposition.

Flemal (1970) considered that the absence of corrensite in stream loads might indicate that it requires a saline environment for formation. Kopp and Fallis (1974) noted that corrensite occurred in association with a well-developed evaporite sequence and suggested that the formation of corrensite needs a re-evaluation and study. They pointed out that if corrensite is a product of leaching, an explanation is in order for its absence from many sediments. If, however, it forms in (hyper-) saline environments, both its presence and absence might be dependent upon physical, chemical, and mineralogical parameters such as a minimum magnesium ion concentration or a minimal temperature *vs* salinity curve. The existence of corrensite deposited both as a replacement product of chlorite and as a vein filling by hydrothermal solutions in the same deposit, as outlined by this report, would further lend reinforcement to the suggestion of Kopp and Fallis (1974). It would appear that a closer look should be taken at the physico-chemical conditions that surround each individual occurrence of corrensite.

### Bibliography

- ALLIETTI, A. (1958) Some interstratified clay minerals of the Taro Valley. *Clay Mineral. Bull.* **3**, 207-211.
- BECHER, A. (1964/65) Eine Tonmineralfolge vom Beckenrand zum Beckeninneren im Buntsandstein Nordost-Bayerns. *Beitr. Mineral. Petrol.* **11**, 586-613.
- BRADLEY, W. F., AND C. E. WEAVER (1956) A regularly interstratified chlorite-vermiculite clay mineral. *Am. Mineral.* **41**, 497-504.
- BRAITSCHE, O. (1960) Mineralparagenesis und petrology der Strassfurtsalz in Reyershausen. *Kali Steinsalz*, **1**, 1-4.
- EARLEY, J. W., G. W. BRINDLEY, W. J. McVEAGH, AND R. C. VANDEN HEUVAL (1956) A regularly interstratified montmorillonite-chlorite. *Am. Mineral.* **41**, 258-267.
- ECHLE, W. (1961) Mineralogische untersuchungen an Sedimenten des Steinmerglkeupers und der Roten Wand aus Umgebrung von Göttingen. *Beit. Mineral. Petrol.* **8**, 25-59.
- FLEMAL, R. C. (1970) Experimentally induced variation and the environmental significance of corrensite. *Trans. Ill. Acad. Sci.* **63**, 178-188.
- FOURNIER, R. O. (1961) Regular interlayered chlorite-vermiculite in evaporite of the Salado Formation, New Mexico. *U.S. Geol. Surv. Prof. Pap.* **424D**, 323-327.
- GRADUSOV, B. P. (1967) Ordered trioctahedral chlorite-vermiculite

- interbedded in Bugety-Say asbestos. *Dokl. Akad. Nauk SSSR*, **172**, 126-127.
- (1969) An ordered trioctahedral mixed-layer form with chlorite and vermiculite packets. *Dokl. Akad. Nauk SSSR*, **186**, 140-142.
- GRIM, R. E., J. B. DROSTE, AND W. F. BRADLEY (1960) A mixed-layer clay mineral associated with an evaporite. *Clays Clay Minerals*, **8**, 228-267.
- JOHNSON, L. J. (1964) Occurrence of regularly interstratified chlorite-vermiculite as a weathering product of chlorite in a soil. *Am. Mineral.* **49**, 556-572.
- KOPP, O. C., AND S. M. FALLIS (1974) Corrensite in the Wellington Formation, Lyons, Kansas. *Am. Mineral.* **59**, 623-624.
- LIPPMAN, F. (1954) Über einen Keuperton von Zaiserweiher bei Maulbronn. *Heidel. Beit. z. Min. u. Petrol.* **4**, 130-134.
- (1956) Clay minerals from the Rot Member of the Triassic near Göttingen, Germany. *J. Sediment. Petrol.* **26**, 125-139.
- , AND M. Y. SAVASCIN (1969) Mineralogische Untersuchungen an Lösungsstruckstanden eines Württembergischen Keupergipsvorkommens. *Tschermaks Mineral. Petrol.* **13**, 165-169.
- PETERSON, M. N. A. (1961) Expandable chlorite clay minerals from upper Mississippian carbonate rocks of the Cumberland Plateau in Tennessee. *Am. Mineral.* **46**, 1245-1269.
- WARSHAW, C. M., AND R. ROY (1961) Classification and a scheme for the identification of layer silicates. *Geol. Soc. Am. Bull.* **72**, 1455-1492.

*Manuscript received, July 26, 1974; accepted  
for publication, April 24, 1975.*