Clays and Clay Minerals, Vol. 28, No. 3, pp. 237–238, 1980.

AUTHIGENIC KAOLINITE IN TILL

Key Words—Authigenic, Growth mechanics, Kaolinite, Quartz, Solution, Till.

This paper reports on an observation of authigenic kaolinite noted during scanning electron microscope (SEM) studies of the microstructure and microtexture of glacial till. The mode of this occurrence has some implications to the growth mechanics involved in kaolinization processes described for example, by Kaye (1967) and Keller (1978), and underlines the problem of trying to decide on a separation between weathering processes and diagenetic processes.

The sample is from an area northeast of Edmonton, Alberta, Canada, in the extreme southwest corner of Sec. 32 Twp. 53R 22W4.

OBSERVATIONS

The material occurs in a pore in a quartz grain embedded in the till matrix, the overall aspects of which are shown in Figure 1A. Figure 1B shows solution pits which seem to have developed primarily along lunate percussion features (Krinsley and Doornkamp, 1973) and possible cleavage planes. The latter feature is well expressed in the upper right portion of the photograph.

Details of the crystal development are shown in Figures 1C and 1D. The former illustrates details of the pore itself showing a hexagonal grain. Above, to both the right and left of this grain, planar boundaries of other similar grains can be seen. Figure 1D illustrates the well developed euhedral grain shown in Figure 1C. This photograph reveals that the grain itself is not perfectly euhedral. Appendages can be seen along both the lower and upper right edges. Similar grains are present in the background. The upper right edge of the main grain exhibits a slight embayment and shows evidence of a form of outgrowth. The grain in the upper right although only partly visible shows some form of spiral growth or twinning similar to that illustrated by Bohor and Hughes (1971, Figure 12a).

X-ray energy dispersive analysis using a Kevex System 7000, show only silicon and aluminum present in the grain illustrated here. Comparison with that of two Georgia kaolin-

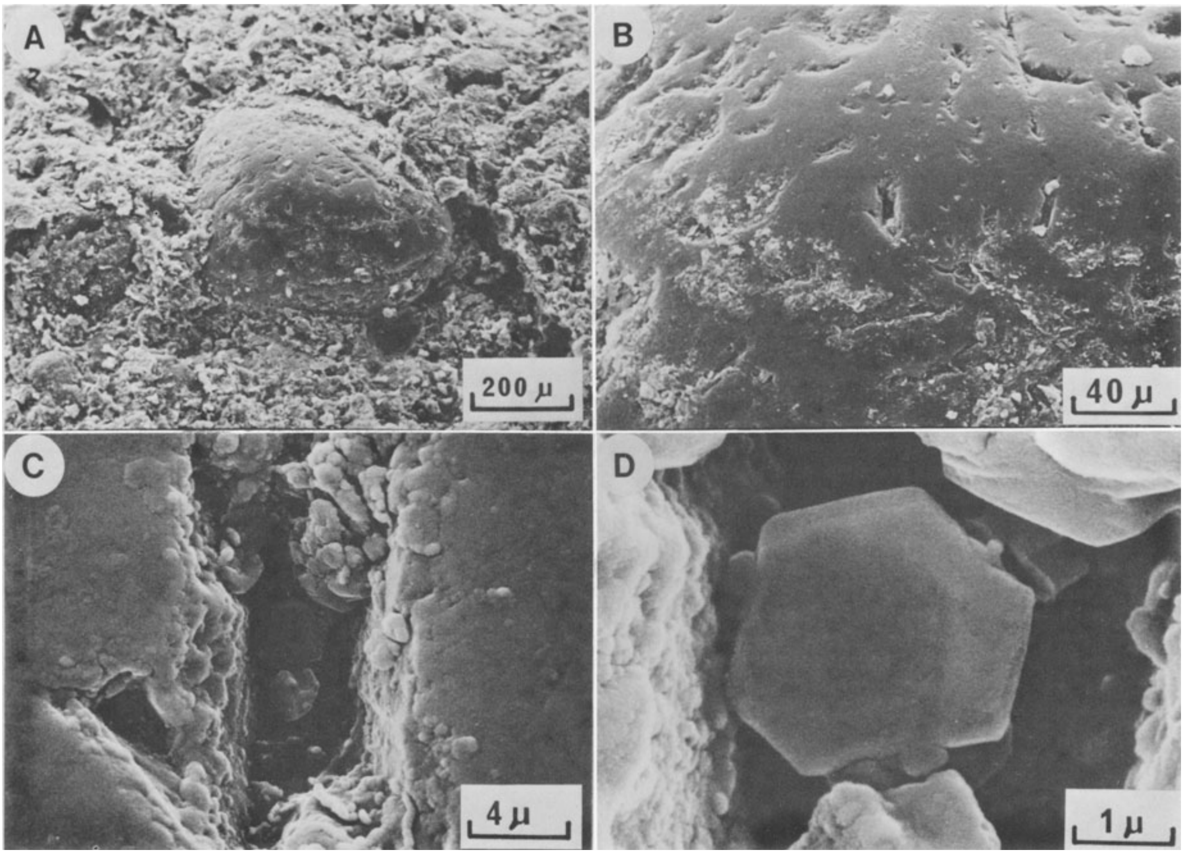

Figure 1. Scanning electron micrographs. A. Quartz grain embedded in till matrix. B. Quartz grain showing solution pitting and percussion marks. C. Solution pore showing aspects of solution features and kaolinite. D. Euhedral kaolinite in solution pore.

https://doi.org/10.1346/CCMN.1980.0280312 Published online by Cambridge University Press

ites, KGa-1 and KGa-2, indicates the proportions of silicon and aluminum are the same in the Georgia samples as in the grain described here.

DISCUSSION AND CONCLUSIONS

Morphological and chemical evidence indicates that the grain described here is kaolinite. Kaolinite has been synthesized in the laboratory under a variety of conditions (Oberlin and Couty, 1970; Kittrick, 1970; Linares and Huertas, 1971; Hem and Lind, 1974), all of which suggest a process which involves the silicification of alumina compounds, mainly gibbsite. The kaolinite described here would seem to have a similar origin. Soluble complexes of alumina were probably carried to the site by percolating surface waters and combined with silica being dissolved from the pore. Consideration of the stability conditions of various alumina complexes (Curtis and Spears, 1971; Roberson and Hem, 1969; Lind and Hem, 1975) suggests that three forms of mobile alumina complexes are possible: gibbsite, organo-Al compounds, and alumino-sulfate compounds. Gibbsite could have been formed by the leaching of alumina from feldspars in the subsoil. Organic complexes involving alumina would form in the A and B horizons and be carried into the C horizon by percolating surface waters. There may be other physicochemical conditions under which this form of kaolinite can be produced, however, the transport of soluble organo-alumina complexes by percolating ground water is favored. If the kaolinite described here formed by the kaolinization of quartz on a microscale, a mechanism involving solution and precipitation of kaolinite must have been involved, rather than some form of direct transformation.

ACKNOWLEDGMENTS

Financial support for this study came from the University of Alberta General Research Grant Fund, Department of Energy, Mines, and Resources, Research Agreement 1135-D13-4-88/76, and from National Science and Engineering Research Council Grant A3838. G. Braybrook assisted with the scanning electron microscopy and L. Buck with the photography.

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(Received 11 June 1979; accepted 28 December 1979)