

NOTE ON THE STRUCTURAL RELATIONSHIPS OF
KAOLINITES AND ANAUXITES

F. MACHATSCHKI, *Mineralogical-petrographic Institute of the
University of Tübingen, Germany.*

In his very interesting paper on the densities and structural relationships of kaolinites and anauxites, Gruner¹ mentions that in my review² of his earlier work on the crystal structure of kaolinite,³ I expressed doubt concerning one of his conclusions, namely, that in the mineral anauxite, which is richer in SiO₂ and poorer in H₂O than kaolinite, the Al (with octahedral 8-coordination) might be partly replaced by Si. In my review³ I mentioned another possibility, as follows: "Das Al(O, OH)-Oktaedernetz enthält ja auch Positionen mit tetraedrischer Anionen-umgebung, in welche die überschüssigen Si-Atome ebenfalls eintreten könnten."

In his recent paper, Gruner¹ calls his original proposal of placing Si ions in the positions of Al ions too drastic, and he gives to the Si ions which replace Al ions in the octahedral network 4-coordinated positions. This requires some distortion of the anion packing. Gruner evidently concluded that I proposed to bring an SiO₄-group into the hexagonal ring shown in Fig. 2 of his paper, for he states: "For example, it would be possible, though unlikely, to place an SiO₄-group in the hexagonal ring shown in Fig. 2, a position to which Machatschki probably referred. The density would be materially increased, however, and a very large part of the H₂O would be lost, obviously a condition not substantiated by the facts." There is evidently a misunderstanding, for I myself do not understand how an SiO₄-group could be brought into this position. Therefore, I take this opportunity to give a further short outline of my suggestion.

The so-called Al(O, OH)-octahedral network of the crystal lattice of kaolinite consists of two layers of close-packed anions. This double layer contains positions with octahedral anion coordination P^[6] as well as positions with tetrahedral anion coordination P^[4]. In kaolinite, two-thirds of the P^[6] positions are occupied by Al ions, and the P^[4] positions are empty. My suggestion is simply the following: in the kaolinites with an excess of SiO₂ (including the anauxites) the P^[6] and the P^[4] positions are statistically and partially occupied by Al and Si ions respectively. This occurs in such a manner, that contrary to the ideal kaolinite lattice, some Al ions are removed and about the same number of P^[4]-positions

¹ *Am. Mineral.*, vol. 22, p. 855, 1937.

² *Neues Jahrb.*, Referate I, p. 439, 1933.

³ *Zeits. Krist.*, vol. 83, p. 75, 1932.

are now occupied by Si ions. Even now neighbouring polyhedrons need only share corners and no edges and faces: at the same time the OH ions of the ideal kaolinite lattice must be statistically replaced in the required amount by O ions; probably not singly, but groups of Al ions will be replaced by groups of Si ions in this way. The relative positions of the anions will remain unchanged; the closest packing, therefore, will not be distorted.

As far as I can see, this proposal is not in contrast with the diminished H₂O content of the anauxites; and even the new careful determinations by Dr. Gruner do not give a clear picture of the real density curve. The cation distribution in the "octahedral networks" of the anauxites may not be quite as tight as in the ideal kaolinite. Still some anions may be removed in the sense of the proposal put forward by St. B. Hendricks.⁴

I can not give, of course, any proof of the suggestion outlined above, at this time; but I prefer this explanation, because Dr. Gruner's proposal involves a rather serious distortion of the anion packing.

⁴ *Zeits Krist.*, vol. 95, p. 247, 1936.