*American Mineralogist, Volume 85, pages 1239–1254, 2000*

# The tremolite-actinolite-ferro–actinolite series: Systematic relationships among cell parameters, composition, optical properties, and habit, and evidence of discontinuities

**JENNIFER R. VERKOUTEREN[1,*] AND ANN G. WYLIE[2]**

[1]Chemical Sciences and Technology Laboratory, National Institute of Standards and Technology, Gaithersburg, Maryland 20899, U.S.A.
[2]Laboratory for Mineral Deposits Research, Department of Geology, University of Maryland, College Park, Maryland 20742, U.S.A.

## ABSTRACT

Unit-cell parameters, optical properties, and chemical compositions have been measured for 103 samples in the tremolite-actinolite-ferro-actinolite series. The average values of the non-essential constituents are: $^{T}$Al = 0.10(11), $^{C}$Al = 0.06(6), $^{B}$(Fe, Mn, Mg) = 0.09(7), $^{B}$Na = 0.04(5), $^{A}$Na = 0.09(9), and Cr, Ti, and K ≅ 0. Asbestiform actinolite samples have lower Al contents than massive or "byssolitic" actinolite samples. Unit-cell parameters for end members tremolite and ferro-actinolite based on regressions of the data are: $a$ = 9.841 ± 0.003 Å, 10.021 ± 0.011 Å; $b$ = 18.055 ± 0.004 Å, 18.353 ± 0.018 Å; $c$ = 5.278 ± 0.001 Å, 5.315 ± 0.003 Å; and cell volume = 906.6 ± 0.5 Å$^3$, 944 ± 2 Å$^3$. The changes in $a$, $b$, and cell volume with ferro-actinolite substitution are modeled with quadratic functions, and the change in $c$ with ferro-actinolite substitution is modeled with a linear function. There is a positive correlation between $c$ and Al that results in a discrimination between asbestiform and massive or "byssolitic" habits for $c$ and for the refractive indices. The principal refractive indices $n_\gamma$ and $n_\beta$ are linear with respect to ferro-actinolite substitution, but $n_\alpha$ is best modeled by two lines with a change in slope between 26 and 32% ferro-actinolite. Birefringence and extinction angle also change between 26 and 32% ferro-actinolite. The predicted end-member values of the principal refractive indices for tremolite and ferro-actinolite are: $n_\alpha$ = 1.602 ± 0.001, 1.661 ± 0.005; $n_\beta$ = 1.621 ± 0.001, 1.692 ± 0.004; and $n_\gamma$ = 1.631 ± 0.001, 1.700 ± 0.003. There is a discontinuity in $a$ at approximately 11% ferro-actinolite that is accompanied by a drop in Ca. There are also indications of discontinuities in optical properties and $c$ between 26 and 32% ferro-actinolite that may be due to an increase in tschermakite substitution. Both discontinuities are accompanied by a decrease in the relative frequency of natural samples.