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# Noncentric Layer Silicates: An Optical Second Harmonic Generation, Chemical, and X-ray Study

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**Abstract:** Twenty-nine chlorites, seventeen lithium-free micas, and twenty-two lithium-bearing micas from diverse localities have been studied by X-ray diffraction, microprobe, and optical second harmonic generation (SHG) techniques to determine which are noncentric and the cause of acentricity. Manandonite (B-rich chlorite) and cookeite, both crystallizing in the *Ia* form, are acentric. Sudoite-*Ib* gave a questionable SHG signal, possibly indicating acentricity. All other chlorites gave null signals. Bityite, a Li,Be mica similar to margarite, was determined from the positive SHG response to be acentric. It crystallizes in the  $2M_1$  form and, by analogy to margarite, is ordered tetrahedrally in subgroup symmetry, *Cc*. Masutomilite-*1M* and "cryophyllite" -*1M* (a zinnwaldite high in Al and Si, but low in Fe) are acentric and most probably crystallize in space group *C2*, thus allowing a noncentric octahedral ordering pattern. Lepidolites showed a diversity in SHG response with only a few being acentric; a lepidolite-*1M* from Mesagrande, California, a lepidolite-*3T* from Windhuk, South West Africa, and a lepidolite- $2M_2$  from Nagatate, Japan, gave positive SHG responses. The Japanese material is complexly intergrown and twinned, and intergrain reflection or refraction may have produced spurious signals.

Most lithium-free micas showed diversity in SHG response and, although most were non-emitters, clintonite from Amity, New York, showed a positive response, but this sample is twinned and shows stacking disorder. A "manganophyllite" -*1M* (manganian phlogopite) from Langban, Sweden, showed a very weak positive response; however, the presence of Mn alone is not sufficient to produce octahedral cation ordering in noncentric subgroup symmetry. Two manganian phlogopites from Japan were refined in subgroup symmetry, and the higher order and ideal symmetry of *C2/m* was confirmed.

**Key Words:** Acentricity • Chlorite • Electron microprobe • Lithium • Mica • Second harmonic generation • X-ray diffraction

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