

## ZONED CLINOPYROXENES AND THE CRYSTALLIZATION OF LAMPROPHYRES

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Calcium-rich clinopyroxenes from Mesozoic camptonite and monchiquite dikes of New England occur as four distinct chemical types, as zones within phenocrysts and/or as homogeneous matrix grains. Type 1 occur as green cores of some phenocrysts, and are sodic (1.0 to 2.3 weight Na<sub>2</sub>O). Type 2 are a pale muddy color, make up most of the middle areas of most grains, and contain intermediate amounts of Ti, Al, Fe<sup>+3</sup>, Cr, and Na replacing diopsidic components. Type 3 are lavender to red-brown phenocryst rims, with 2.2 to 4.4 weight % TiO<sub>2</sub>. Type 4 are gray brown aluminous (10.0 to 16.2 weight % Al<sub>2</sub>O<sub>3</sub>) pyroxenes found in some ultramafic dikes. Where they occur together, zone boundaries and colors are distinct enough to optically discriminate among the types. Coupled substitutions for Ca, Mg, and Fe<sup>+2</sup> are too abundant (9 to 40 atomic %) for classification by the pyroxene Di-Hd-En-Fs quadrilateral, usually with Ca/(Ca+Mg+Fe<sup>+2</sup>) exceeding 50 %. Although the clinopyroxenes were growing during much of the crystallization of the lamprophyre magmas, there is little systematic increase in Fe<sup>+2</sup>/(Fe<sup>+2</sup>+Mg) from core to edge of the grains. The varieties of crystal chemistries in the pyroxenes apparently are linked to delayed crystallization of feldspar, early crystallization of kaersutite and pyrite, resorption of olivine, and changes in oxygen fugacity. The high degree of substitutions in lamprophyre clinopyroxenes illustrates crystallization patterns that differ from crystal-chemical trends of most other magmas.