Magnesiodumortierite, a new mineral from very-high-pressure rocks (western Alps).
II. Crystal chemistry and petrological significance

CHRISTIAN CHOPIN¹, GIOVANNI FERRARIS², GABRIELLA IVALDI², HANS-PETER SCHERTL³, WERNER SCHREYER³, ROBERTO COMPAGNONI², CAMERON DAVIDSON⁴ and ANDREW M. DAVIS⁵

¹ Laboratoire de Géologie, École normale supérieure, 24 rue Lhomond, 75005 Paris, France
² Dipartimento di Scienze Mineralogiche e Petrologiche, Università di Torino, Via Valperga Caluso 37, 10125 Torino, Italy
³ Research Group on High-Pressure Metamorphism, Institut für Mineralogie, Ruhr-Universität, 44780 Bochum, Germany
⁴ Geologisches Institut der Universität, Bernoullistrasse 32, 4056 Basel, Switzerland
⁵ The Enrico Fermi Institute, The University of Chicago, 5640 Ellis Avenue, Chicago, Illinois 60637, U.S.A.

Abstract: Magnesiodumortierite occurs as rare inclusions in pyrope megablasts of the coesite-bearing "white-schists" of the Dora-Maira massif, western Alps, together with kyanite, talc, clinohlore, ellenbergerite and rutile. Textural evidence suggests that it formed as a primary phase (together with ellenbergerite, at about 25-30 kbar, 700°C) and as a somewhat later phase during early decompression. Magnesiodumortierite is orthorhombic, biaxial (-), a = 1.678(1), b = 1.700(1), c = 1.701(1), 2V_p = 38.5 ± 1.0°, X/c. The pleochroism, X pale pink to red, Y and Z colourless, is due to an Fe²⁺-Ti⁴⁺ charge-transfer absorption band at 20,300 cm⁻¹. Cell parameters are a = 11.91(3), b = 20.40(3), c = 4.730(2) Å, space group Pmcn, Z = 4, Dcalc = 3.22 Mg/m³.

Magnesiodumortierite is isostructural with dumortierite, with Mg as the dominant cation in the single chain of face-sharing M₁ octahedra. Chemical variations among eight samples ranging in Ti content show that, with respect to dumortierite, complete replacement of Al in M₁ by Mg and vacancies is charge-compensated by additional protons. Ti incorporation proceeds additionally by the mechanism Ti + Mg for 2 [Al⁺²⁻/³⁺]Mg, leading to partial replacement of Al by Mg in M₄. The resulting compositions range from a Ti-free end-member close to (Mg₁₋ₓ, Dₓ)Al₂Al₂Si₅O₁₁·2x(HOH)₂B (x = 1/3) toward (Mg₁/₃, Ti₁/₃, Al)₀.₅Mg₀.₅₂Al₂Si₂O₁₀(OH)₂B. Phase-relation analysis suggests that the substitution leading from dumortierite to Ti-free magnesiodumortierite (Mg + H⁺ for Al in the single chain) is favoured by increasing pressure, the Mg content in the dumortierite phase being buffered at a maximum value by its coexistence with chlorite + garnet (at fixed H₂O and B₂O₃ activities).

Key-words: magnesiodumortierite, new mineral, high-pressure phase, Dora-Maira massif, dumortierite group, boron.

Introduction

The orthorhombic aluminium-borosilicate dumortierite, ideally (Al₁₋ₓ, Dₓ)Al₂Al₂Si₅O₁₁·2x(OH)₂B (Moore & Araki, 1978), was described by Bertrand (1880) and is notoriously difficult to analyse (Schaller, 1905). Classical analyses usually have low contents of boron (Claringbull & Hey, 1958), while boron and water are ignored in electron-microprobe analyses (Alexander et al., 1986; Schertl et al., 1991; Visser & Senior, 1991; Taner & Martin, 1993). Recent complete