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Compression of Garnet to 100 Kilobars

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The compression of a natural Mg-rich garnet to pressures greater than 100 kb was studied by a high-pressure in situ X-ray powder-diffraction method. A quadratic least-squares fit to the data yields a rough value for the bulk modulus of 1750 kb. The results are in agreement with the compression data found by Takahashi and Liu (1970), who used a different high-pressure X-ray diffraction technique, and with the results of Soga (1967), who used an ultrasonic technique.

This study of the compression of an Mg-rich garnet is the second in a series of reports on the compression of minerals thought to be major constituents of the earth's upper mantle. The first was a study of the compression of Mg-rich olivine [*Olinger and Duba,* 1971]. Past investigations conducted on the members of the almandite-pyrope garnet series $(Fe, Mg)_3Al_2(SiO_4)_3$ are listed by *Birch* [1966, p. 132] and by *Takahashi and Liu* [1970]. Attention will be given here to two recent works, *Soga's* [1967] investigation of the elastic constants and their pressure derivatives in an Fe-rich member of the series and *Takahashi and Liu's* [1970] compression study of four members of the series using a high-pressure in situ X-ray powder-diffraction technique.

SPECIMEN AND EXPERIMENTAL METHOD

The specimen studied was a garnet crystal extracted from a serpentinized peridotite from Zöblitz, Czechoslovakia. The crystal was ground to a fine powder, its cell parameter (11.554 ± 0.009A) was determined from X-ray powder-diffraction film by using a 114.6-mm Debye-Scherrer camera and CuK_α radiation, and its chemical composition (Table 1) was determined by using a microprobe.

The high-pressure in situ X-ray diffraction technique used was described by *Jamieson* [1964, 1965]. Briefly, the powdered garnet sample was mixed with powdered NaF (2:1 by volume), pressed into a pellet 0.40 mm in diameter and 0.25 mm high, set into a powdered amorphous boron annulus, and this assembly was then pressed between two tungsten-carbide pistons by a small-tonnage hydraulic ram. A collimated, filtered MoK_α X-ray beam was passed through the sample perpendicular to the axis of the pistons, and the subsequent diffracted rays were recorded on a film mounted concentrically 114.6 mm from the sample. Pressures in the sample region were deduced from the compression of the NaF by referring to *Olinger and Jamieson* [1970]. Errors to be expected in correlating the NaF compression to pressure are within ±6 kb at 100 kb.

EXPERIMENTAL RESULTS

Two series of high-pressure runs yielded 34 diffraction patterns of the garnet and NaF. One series was made with a previously uncompressed boron annulus to achieve in situ diffraction patterns in the higher-pressure region (50–

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