05.1-31 STRUCTURAL DEFORMATION OF EXPERIMENTALLY SHOCK-LOADED FORSTERITE (Mg_2SiO_4). By H. Schneider, Forschungsinstitut der Feuerfest-Industrie, An der Elisabethkirche 27, D-5300 Bonn and E. Tillmanns, Mineralogisches Institut, Am Hubland, D-8700 Würzburg, Federal Republic of Germany.

Single crystal discs of forsterite (Mg_2SiO_4) cut parallel to (001) were experimentally shock-loaded to a peak pressure of ≈59 GPa with the shock-wave direction parallel to the crystallographic c-axis. Experimental procedures have been described by Schneider et al., Phys.Chem.Minerals, 1984, 10, 142-147. The shock-induced deformation effects of forsterite were analysed by single crystal X-ray techniques. No significant changes of lattice constants do occur in the shocked crystals, although slight broadening of X-ray reflections indicates some lattice strain. The streaking of X-ray reflections is strong in the b*, c*- plane, for h0l and kk0 reflections it is much weaker. This indicates a shock-induced structural deformation caused by rotational movements of relatively large domains around $\vec{a}$ in (100), the plane of the approximate close packing of oxygen atoms in forsterite. Each 0kl reflection streak exhibits two intensity maxima which shows that the domains are preferably arranged in two different orientations with the a-axis in common but rotated against each other by an angle of about 14°.
While the Laue group mmm of olivine is apparently not changed by the shock-wave, additional h0l reflections with h+l=2n+1 violate the extinction conditions for the space group of olivine (Pbnm) and lead to space group $Pb2_1m$. Crystal structure determinations of forsterite at elevated pressures (e.g. Hazen, Amer.Min., 1976, 61, 1280-1293) have shown that the geometries of SiO_4 tetrahedra are practically insensitive to pressure. Therefore the reduction of symmetry is probably not caused by tetrahedral distortions. Possible mechanisms in correspondence with the observed symmetry are small rotations of SiO_4 tetrahedra against each other around $\vec{c}$ or small displacements along $\vec{b}$ with no principal changes in the distorted close-packed arrangement of oxygen atoms.

05.1-32 ON THE MARTENSITIC PHASE TRANSFORMATION proto-clinc ENSTATITE. By H. Schrader, H. Boysen, F. Frey, Institut f. Kristallographie, Universität München, FRG, P. Convert, ILL, Grenoble, France, and G. Eckold, KFA Jülich, FRG.

Enstatite ($MgSiO_3$) usually has two phases at ambient temperatures: orthoenstatite (oe,Pbca) and/or clinoenstatite (ce,$P2_1/c$). Above 1300 K a new phase protoenstatite (pe,Pbcn) is stable. The backtransformation pe→ce starting at about 1000 K is martensitic (Smith, Am.Min. 59(1974), 345). The structures can be envisaged approximately as different stacking sequences in a*-direction of planes of parallel (SiO_4)-chains: ++++...(oe),++--++...(oe) and +-+-+...(pe), where + and - refer to a shift in c-direction. All investigations were carried out on natural crystals from Bamble/Norway (~2% Fe). At all temperatures X-ray photographs show diffuse streaks in a*-direction, which are of static origin as deduced from elastic neutron scattering experiments at the UNIDAS (KFA Jülich). The number of the corresponding stacking faults increases slightly near the pe→ce transition becoming constant below it.

In order to look for possible precursor effects the initial dispersion branches of the transverse acoustic modes along [ξ00] and [00ξ] have been determined near the Γ-point in the transformation region. Both correspond to the c_{55} elastic constant, which is connected with a shear in the a,c-plane necessary for the transformation. Whereas no anomaly was found along [ξ00], the slope of the dispersion branch along [00ξ] increases slightly several degrees above the transition and becomes normal below it again. This anomalous stiffening of the force constant can be correlated with the simultaneous increase of the number of stacking faults (the eigenvector of this mode is parallel to a) and has thus to be regarded as a secondary effect, i.e. the transformation is triggered by some other mechanism possibly nucleation at the stacking faults.

The kinetics of the transformation and the variation of the structural details have been studied by neutron powder diffractometry on the instruments D1A and D1B at the ILL/Grenoble. Reliable structural parameters have been determined just above and below the transition with the high resolution instrument D1A. In pe an analysis of the anisotropic thermal parameters revealed large amplitude motions of the SiO_4-tetrahedra around axes being roughly parallel to the chains. Especially large displacements result for the oxygens linking the tetrahedra. A series of experiments has been done on the high intensity instrument D1B with different time - temperature gradients (10 min measuring time per pattern). No discontinuous changes of relative intensities have been observed at a rate 10 K/ 10 min, whereas a distinct transformation takes place at 50 K/ 15 min and higher rates. Measurements at constant temperatures within the transition region show the athermal behaviour. Starting from the D1A structural parameters the temperature dependence of the most sensitive parameters has been evaluated. Parameters and the volume ratios of the different phases will be reported.

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