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(s.g. P₃12, a=5.2248(6)Å, c=29.737(5)Å) converged to R=3.5. According to the values of the refined electron content no ordering occurs in the octahedral sites (14.3(2) el in M2 and 14.7(2) el in M3); a significant electron density residual (about 0.7 el in the ΔF; 0.3(1) el refined value) occurs in the 'empty' M1 site. These results are in agreement with the WDS electron-probe chemical analysis (K_{0.95}Na_{0.01}Ba_{0.01})(Al_{1.37}Fe_{0.26}Mg_{0.41}Ti_{0.02})Σ=2.06(Si_{3.48}Al_{0.52})O₁₀(OH)₂ which shows slightly more than two M cations corresponding to 29.93/2.06=14.53 el for M2 and M3, 0.87 el for M1.

By optical microscopy a minor lamellar mica phase is observed within the matrix of phengite. These lamellae are of brown colour, uniaxial and in the same optical orientation of the matrix. The following crystal-chemical formula (K_{0.63}Ca_{0.01})(Al_{0.51}Fe_{0.76}Mg_{1.38}Ti_{0.09})Σ=2.65(Si_{3.18}Al_{0.82})O₁₀(OH)₂ is obtained from the data of an EDS electron-probe chemical analysis. Also taking into account the poor quality of the data, due to the very small dimensions of the lamellae, the brown sample shows phlogopitic composition.

An X-ray powder diffraction pattern on the natural sample confirms the presence of two trigonal phases with clearly different unit cells: a minor one (green phengite, a=5.214(4)Å, c=29.77(1)Å) and a major one (brown mica, a=5.28(1)Å, c=30.04(5)Å). All the brown lamellae examined by single-crystal X-ray diffraction showed trigonal symmetry, except for one resulting in a 1 M monoclinic polytype.

One can assume the following subsequent events took place: crystallization of 3T phengite at high P/T conditions; exsolution of iso-oriented 3T phlogopite within the phengite matrix; minor phase transition of the phlogopite from 3T to 1 M symmetry.

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SYNDEFORAMTIONAL REACTION OF PLAGIOCLASE AND OLIVINE IN EXPERIMENTALLY DEFORMED PLAGIOCLASE-OLIVINE AGGREGATES

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We investigated the effect of chemical disequilibrium on the deformation of plagioclase peridotite by performing simple shear deformation experiments on plagioclase-olivine mixtures at 900°C and confining pressures of 1.0 and 1.5 GPa.

In An₉₂-Fo₉₂ mixtures the applied confining pressures represent different degrees of overstepping on the mineral reactions Plg + Ol = Sp + Px and Plg + Ol = Gt + Px and produce chemical

reactions. An₆₀-Fo₉₂ mixtures, also used in experiments, are in chemical equilibrium at these confining pressures, and allow the study of crystal plastic deformation of non-reacting samples.

Mixtures of olivine(2):plagioclase(1) were prepared from 2-6 μm powders of Fo₉₂, An₉₂ and An₆₀. The mixtures were placed between dunite pistons, cut at 45 degrees to the compression direction. Prior to deformation, the samples were heated at 1000°C for 6 hours in a CO-CO₂ gas mixture and subsequently hot pressed for 24 hours at 0.7 GPa and 900°C. Our experiments were carried out in a Griggs apparatus under a constant strain rate of 5x10⁻⁵sec⁻¹.

In absence of reaction, An₆₀-Fo₉₂ and pure olivine samples show strain hardening with no yield up to stresses equal to the confining pressure.

Significant reaction induced weakening is observed in the An₉₂-Fo₉₂ samples deforming at lower stresses than pure olivine and unreacted samples.

The syndeformational reaction between An₉₂ and Fo₉₂ results in fine-grained (<1 μm) Ol-Sp-Gt-Px reaction products. These products form along An₉₂-Fo₉₂ grain contacts. They coalesce and accommodate most of the deformation by granular flow.

The mineral reaction is not observed in an undeformed An₉₂-Fo₉₂ sample, held hydrostatically at 900°C-1.5 GPa for the same duration as the deformation experiments.

Hence, the Fo₉₂-An₉₂ syndeformational reaction is enhanced by the deformation. The reaction itself is associated with a switch in deformation mechanism from crystal to granular flow of reaction products.

WATER DIFFUSION IN NATURAL OLIVINE AND SYNTHETIC FORSTERITE

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The interaction on upper mantle minerals with water is known to have a major influence of a range of physical and chemical properties. Thus, characterization of solubility and kinetics of incorporation for water in nominally anhydrous minerals is important in order to understand the behavior of Earth's deep interior. Experimental studies on the olivine-water system indicate that significant amounts of OH can dissolve within olivine as point defects (Bell and Rossman, 1992; Kohlstedt *et al.*, 1996; Kohlstedt and Mackwell, 1998).

Our study is based on hydrogenation of single-crystal samples by piston-cylinder and TZM cold-seal vessel experiments. We use FTIR analyses in order to constrain the speciation of the mobile water-derived defects in iron-bearing and iron-free olivine, and the rates of diffusion of such species under uppermost mantle conditions (0.2 to 1.5 GPa, 900 to 1100°C, 1 to 20 hours). Hydrogen defect transport in single crystals of olivine and forsterite is investigated for diffusion parallel to each crystallographic axis. Defect diffusivities are obtained by fitting a diffusion law to the OH content as a function of position in the sample.

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Our current results indicate that incorporation of hydrogen species into iron-bearing olivine is a 2-stage process with an initial stage of proton-polaron exchange ($D_H = D/2 = 10^{-11}$ m²/s at 1000°C parallel to [100]). The different concentration profiles show a clear anisotropy of diffusion, with fastest diffusion parallel to [100]. On a longer time scale, diffusion of hydrogen species occurs through incorporation of proton-metal vacancy pairs ($D_V = D/3 = 10^{-12}$ m²/s at 1000°C parallel to [001]), with fastest diffusion along [001]. Although there is no proton-polaron exchange in iron-free forsterite, we have quantified the second process of incorporation in samples of synthetic forsterite, which display similar behavior to the iron-bearing samples.

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OXYGEN IONIC CONDUCTIVITY IN MgSiO₃ PEROVSKITE: POSSIBLE PRE-MELTING SIGNAL?

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MgSiO₃ perovskite is thought to be the major constituent of the Earth's lower mantle. Consequently, knowledge of its chemical and physical properties is fundamental to our understanding of the processes occurring within the deep Earth.

We have measured the electrical conductivity of MgSiO₃ perovskite with a NaSiO_{2.5} content of 0.3 mole%. This results in an extrinsic oxygen vacancy content of 0.0015 PFU and should ensure that these are the dominant charge carriers in the experimental temperature range (1273-2133 K). At 24-26 GPa the electrical conductivity of this perovskite increases Arrheniusly between 1273 and 1900 K with an activation energy of 1.4 eV, consistent with predicted oxygen mobility. Using the Nernst-Einstein equation to calculate the O-diffusivity from these data suggests that O²⁻ will be 10 to 100 times more mobile than Si⁴⁺ in MgSiO₃ perovskite.

There is a discontinuous change in conductivity at 1900 K, with the high temperature region having an activation energy closer to 4 eV. This change is reversible and reproducible. The high temperature region is most likely to be due to either a change from extrinsic to intrinsic conduction, or pre-melting of the oxygen sub-lattice. The discontinuous nature of the transition leads us currently to favour pre-melting, however we require further experiments to confirm this.

Pre-melting of the anion sub-lattice is observed in many perovskite structured materials and often accompanies the transition to cubic symmetry. The change in electrical conduction mechanism observed here occurs at a rather low homologous temperature ($T/T_m \sim 0.75$) for pre-melting phenomena. We note, however, that it is close to recently observed transition temper-

atures, and the temperature at which laser heating power-temperature relationships undergo a discontinuous change in MgSiO₃ perovskite.

If pre-melting does occur in MgSiO₃ perovskite under P-T conditions pertinent to the Earth, this will significantly affect the physical properties of the lower mantle.

DATA BANK FOR PETROLOGY AND GEOCHEMISTRY OF VOLCANICS FROM ERCIYES MOUNTAIN, CENTRAL ANATOLIA, TURKEY

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We have collected about 300 data for major oxides including SiO₂, TiO₂, Al₂O₃, Fe₂O₃ or FeO, MnO, MgO, CaO, Na₂O, K₂O, P₂O₅, H₂O or LOI; and trace elements including Ba, Rb, Sr, Y, Zr, Nb, Th, Pb, Ga, Zn, Cu, Ni, V, Cr, Hf, Cs, Ta, Co, Li, Be; and rare earth elements including La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu. We evaluated the data using Harkers diagrams for accuracy and consistency; and applied discriminant diagrams using MinPet and NewPet programs. We observed inconsistencies on classifications, magmatic and tectonic environments. We also applied some 30 of our data to the Erciyes volcanics. We hope that this will help to evaluate the Central Anatolian volcanics quantitatively.

DATA BANK FOR PETROLOGY AND GEOCHEMISTRY OF VOLCANICS FROM HASANDAG-MELENDIZ MOUNTAINS, CENTRAL ANATOLIA, TURKEY

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We have collected about 350 data for major oxides including SiO₂, TiO₂, Al₂O₃, Fe₂O₃ or FeO, MnO, MgO, CaO, Na₂O, K₂O, P₂O₅, H₂O or LOI; and trace elements including Ba, Rb,

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Sr, Y, Zr, Nb, Th, Pb, Ga, Zn, Cu, Ni, V, Cr, Hf, Cs, Ta, Co, Li, Be; and rare earth elements including La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu. We evaluated the data using Harkers diagrams for accuracy and consistency; and applied discriminant diagrams using MinPet and NewPet programs. We observed inconsistencies on classifications, magmatic and tectonic environments. We also applied some 30 of our data to the Hasandag-Melendiz volcanics. We hope that this will help to evaluate the Central Anatolian volcanics quantitatively.

SI AND O DIFFUSION RATES IN OLIVINE AND DIOPSIDE AS A FUNCTION OF fO_2 AND ACTIVITY OF ENSTATITE: THE CONNECTION BETWEEN DISLOCATION FLOW AND DIFFUSION VIA POINT DEFECTS

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Oriented single crystals coated with thin films enriched in ²⁹Si and ¹⁸O have been used to study the simultaneous diffusion of Si and O in minerals such as olivine and diopside. The thin films were produced by pulsed laser deposition, a versatile method which provides well controlled chemistry and geometry, as characterized by Rutherford-Backscattering analysis, Interference Microscopy and Transmission Electron Microscopy (Dohmen et al., *subm. to EJM*). As produced, the thin films are amorphous (typical thickness 200-300 nm), but after pre-annealing the films crystallize as uniform polycrystalline layers with ideal contact to the single crystal substrate.

Diffusion experiments were performed at 1100-1500°C under controlled oxygen fugacity (CO-CO₂ gas mixture) and in case of olivine (Fo₉₀) the silica activity was controlled additionally using solid state buffers (magnesiowuestite or orthopyroxene). The isotopic depth profiles along the c-axis (~0.58 nm) of unannealed, pre-annealed, and annealed samples were measured using SIMS (University of Edinburgh).

Our results show that O-diffusion in olivine is much faster than Si-diffusion as expected from earlier studies [Gerard & Jaoul, 1989; Ryerson et al., 1989]. Activation energies for diffusion are found to be 344 ±13 kJ/mol for oxygen and 511 ±25 kJ/mol for Si in olivine. Both diffusion rates increase with increasing silica activity, whereas only oxygen diffusion in olivine is affected by oxygen fugacity. Our diffusion coefficients are smaller than those measured in earlier studies, by up to two orders of magnitude for Si in olivine [Houlier et al., 1990]. The activation energy for Si diffusion as well as its dependence on silica activity is identical to that measured for dislocation flow in single crystal olivines. This result provides a simple connection between atomistic diffusion jumps and macroscopic deformation behavior, and removes the necessity for complex models relating the two. Work is in progress to determine the activation energy for diffusion in diopside, to test if this relationship can be extended to silicates in general.

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SELF-CONSISTENT EQUATION OF STATE OF MINERALS UP TO 3000 K AND COMPRESSION UP TO X=0.6

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The self-consistent calculation of thermodynamic functions of minerals requires strong thermodynamic relationships between all thermodynamic functions. However, data treatment on heat capacity, thermal expansion coefficient, volume and adiabatic bulk modulus, as a rule, is performed without considering the volume as a function both of temperature and pressure. In a similar manner, data treatment on volume that can be measured by current methods up to 3000 K and 200 GPa is carried out without taking into account heat capacity and other energy properties at zero pressure. Hence, the energy and volume properties of solids from different sources, even the most authoritative ones, cannot be considered as self-consistent.

The main purpose of this study is to extend the Zharkov and Kalinin (1971) formalism to range 0-3000 K and up to compression $x=V/V_0=0.6$. The Helmholtz free energy written as: $F(V,T)=U_0+E(V)+F(V,T)+F_a$, where $E(V)$ is a part of energy depending only on volume, $F(V,T)$ is a thermal part of the free energy (quasiharmonic part), F_a is the anharmonic part.

Energy vs. volume at 0 K isotherm may be expressed in a number of convenient forms. The thermal part of the free energy is expressed by the Bose-Einstein and Einstein functions (Kut'in and Pyadushkin 1998). Entropy, internal energy, heat capacity at constant volume, thermal pressure, bulk modulus and dP/dT can be easily obtained from the free energy. The volume dependence of the Grüneisen parameters and characteristic temperatures are written in the form proposed by Molodets (1995). The intrinsic anharmonicity, which is important at high temperatures, has to be taken into account; the classical anharmonic free energy expression ($F_a = aT^2$) and other model expressions were found to work quite well.

In this report we will discuss equations of state of NaCl (Dorogokupets, 2001), corundum and periclase.

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