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Incorporation of Ca-Eskola component in eclogitic clinopyroxene in CMAS and "natural" composition at upper mantle conditions

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High-pressure phase equilibria studies in combination with measurements of seismic wave velocities provide insights into the mineralogy and structure of the Earth´s interior. Some seismic studies reveal the presence of a seismic discontinuity at 260-330 km depth called X-discontinuity (Revenaugh & Jordan, 1991). The petrological causes for the X-discontinuity are currently debated but one possibility involves the coesite/stishovite transformation and the exsolution of "excess" SiO_2 from Ca-Eskola-bearing clinopyroxene ($Ca_{0.5}$$_{0.5}Si_2O_6$) in an eclogitic mineral assemblage (Williams & Revenaugh, 2005). A critical aspect of this model is the amount of free SiO_2 in eclogite to produce a seismic impedance contrast. Here we present first results of an experimental investigation on the stability of CaEskola-bearing clinopyroxene (cpx) in the CMAS system in comparison to more "natural" model eclogite compositions as a function of P, T and bulk composition.

High-pressure experiments were conducted in a P-T- range of 4-11.5 GPa and 1000-1350˚C. Starting materials were powdered glasses with bulk compositions in the simple system (CaO-MgO-Al_2O_3-SiO_2±Na_2O) and "natural" model compositions (K_2O-Na_2O-CaO-MgO-FeO-Al_2O_3-SiO_2). The clinopyroxene in the CMAS system can be defined by the pyroxene solid solution end members: diopside – calcium-Tschermaks – calcium-Eskola – and clinoenstatite (±jadeite). In the "natural" system Fe- and K-bearing components are also present.

In the simple CMAS system (±Na)all run products have a typical eclogite assemblage and are SiO_2saturated. Clinopyroxene is in equilibrium with garnet (grt) and coesite or stishovite, and in some runs kyanite is also present. With increasing pressure, the amount of grt increases at the expense of cpx. The total amount of cpx also depends on the starting composition and increases with T at constant P. All cpx are non-stoichiometric because of the defect-bearing Ca-Eskola component. The amount of Ca-Eskola depends on the bulk composition, particularly on the Al_2O_3content and decreases with pressure, but increases with temperature. An interesting point is that the proportion of the SiO_2-polymorph increases with pressure while the content of CaEs decreases. These P-T-X systematics will be compared with analogous experiments performed with more "natural" eclogitic compositions containing Fe and alkalis.

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