Deformation experiments on natural omphacite: A TEM study

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The rheological behaviour of eclogite is dominated by the deformational properties of omphacite which therefore are most important for the geodynamic processes of subduction and exhumation of oceanic and continental crust. The deformation mechanisms activated are obviously not the same in eclogites from different geological areas as shown by several transmission electron microscopy (TEM) studies. In order to attribute the specific microstructures of omphacite to the deformation conditions of the eclogite in its geological environment, deformation experiments on natural omphacite under conditions of high pressure metamorphism have been started. The source material was fibroblastic omphacite with the space group P2/n from Tianshan (Gao and Klemd, 2001). TEM showed that it contained small-angle grain boundaries formed by crystal growth and the common 1/2[110] antiphase domains. The experiments were conducted using a Deformation-DIA (D-DIA) high-pressure apparatus at a strain rate of 10^{-5} s^{-1}, a confining pressure of 2 GPa, and temperatures between 800 °C and 500 °C.

The omphacite deformed at 800 °C had still the space group P2/n, was well-ordered and showed (in addition to the defects in the omphacite as-grown) deformation twin lamellae on (100) with widths which varied between a few nm and about 0.5 µm. Deformation twin lamellae on (100) have been repeatedly observed in omphacites from eclogites of various occurrences but not in all (Godard and Van Roermund 1995; Müller *et al*. 2004). Defects parallel to (100) which apparently consist of numerous dislocations lined up parallel to (100) were seen in one area of the specimen. They are interpreted as precursors of twin lamellae; these microstructures have not been reported before. In addition, planar faults parallel to (110) and (1-10) stretched between dislocations have been observed. They may be similar or identical to crystallographic shear planes parallel to (110) which were found for the first time in the ultra-high pressure metamorphic rocks of Lago di Cignana (Müller and Compagnoni 2007, unpublished). Chain multiplicity faults parallel to (010), however, which are so frequent in omphacite from the Lower Schist Cover of the Tauern Window (Müller *et al*. 2004), have not been observed so far in the experimentally deformed omphacite.

References

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Impact of future Greenland deglaciation on global weathering fluxes and atmospheric CO_2

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About 1.76×10^6 km^2 of Greenland are currently covered by ice. It is expected that this large ice mass will melt away over the next 3000 years if anthropogenic CO_2 emissions continue to rise (Alley *et al*., 2006). As a result, the bedrock currently covered by ice will lie free and become subject to chemical weathering. The resulting weathering fluxes will contribute to increase both the consumption rate of atmospheric CO_2 and the production rate of riverine HCO_3^-. Increasing these two fluxes will tend to decrease the atmospheric CO_2 partial pressure, as a result of the modified ocean-atmosphere carbon cycle. Chemical weathering may thus possibly act as a negative feedback in the Greenhouse World. Other changes (e.g., vegetation cover and additional climate change) concomitant with the melting of the Greenland ice-sheet may either amplify or dampen, if not reverse the weathering effect.

Here we use the intermediate complexity Earth System model CLIMBER-2 to quantify and analyse the weathering flux changes that result from the projected melting of the Greenland ice sheet and the implications for atmospheric CO_2. The biogeochemical module of CLIMBER-2 has been extended to account for the consumption of atmospheric CO_2 and the production of riverine HCO_3^- by continental weathering processes, as a function of geographically distributed runoff (interactively provided by the CLIMBER-2 climate module) and lithology (derived from Amiotte Suchet *et al*., 2003). We find that the increased weathering processes alone would lead to a sustained 0.2 ppm/kyr decrease in atmospheric pCO_2. The climate change resulting from the deglaciation of Greenland reduces the magnitude of this trend to 0.1 ppm/kyr. Only in the case where the effect of freshly comminuted bedrock is taken into account (Clark *et al*., 2006) does the weathering feedback help to reduce atmospheric pCO_2 by about 10 ppm in 5000 years.

References

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