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Microstructures developed during natural and experimental decompression of mantle peridotite at pressures 14→5 GPa

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Minerals with stability fields restricted to very high pressures (e.g. coesite and diamond) are now known from many continental collision zones of many ages. In addition, mineral associations and microstructures suggestive of extremely high pressures, perhaps representing the mantle transition zone or even the lower mantle, have now been documented from a wide variety of Ultra-High-Pressure metamorphic rocks, both from xenoliths in kimberlites and related volcanic rocks, and from continental collision zones. Here we discuss several of these microstructures in terms of how reliable may be the inferences of very great depth. As additional new and perplexing observations emerge from UHPM terranes, the need will grow for experimental investigations of a wide variety of bulk chemistries representing continental rocks and sediments as well as mantle compositions. We have begun such experiments on decompression of peridotite from conditions of the mantle transition zone: Experiments conducted at 14GPa, 1673K, resulted in all enstatite (En) and about 85% of diopside (Di) being dissolved into garnet (Grt), yielding run products of approximately 40% olivine (Ol) + 55% Grt + 5% Di. Grt was supersilicic with Si=3.17-3.31 p.f.u. Reannealing of this product at 13 or 12 GPa resulted in exsolution of Di and wadsleite/Ol, with the latter appearing as micron-size oriented platelets on Grt subgrain boundaries whereas Di exsolved only as blebs at garnet grain boundaries. In specimens annealed at 5 GPa after previous equilibration at 8GPa, 1673K, En exsolved as blebs at garnet boundaries. The latter result is very similar to interstitial blebs of En reported along

garnet grain boundaries in deep-seated (>200 km) Norwegian UHPM grt-peridotite (e.g. van Roermund et al., 2001). In the latter rocks, En and Di with typical exsolution microstructures also have been found in the cores of large garnets. Our experiments do not show the intracrystalline ppts., supporting the arguments of van Roermund and Drury (1998) that such lamellae are only produced in the cores of very large grains and that the interstitial pyroxenes found in their specimens are also exsolution products. Our finding of exsolved wadsleyite and Ol suggest that the occasional olivine observed naturally by van Roermund and colleagues is also an exsolution product.