Feedback between magma-fluids percolation and deformation in Kimberley mylonitic mantle xenoliths shallow Kaapvaal cratonic roots, South Africa

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We present the results of an integrated petrological, microstructural and geochemical study of mantle xenoliths sampled by kimberlitic magmas in the Kaapvaal craton (South Africa). Microstructures, crystal preferred orientations, water contents and major and trace elements compositions have been analyzed in 7 mylonitic mantle xenoliths carry from deep upper mantle (~150 Km) and distinguished by high equilibrium T (1000-1200°C). These highly deformed xenoliths display a bimodal grain size (large porphyroclasts (~ 5mm) of olivine, orthopyroxene and garnet in a matrix of very fine neoblasts (<0,1 mm)). Geochemical analyses indicate that sampled suffered multiple metasomatic events resulted in orthopyroxene enrichement or secondary crystallization of clinopyroxene and phlogopite.

Olivine Crystallographic preferred orientation (CPO) recording dominant orthorhombic symmetry with [100] axes aligned close to the lineation and [010] axes normal to the foliation plane. Most of the samples show olivine [001] and orthopyroxene [001] axes parallel, suggesting dominant [001] glide. The coherent Orthopyroxene and Olivine CPO suggest pre- to syn-Kinematic orthopyroxene enrichement. Deformation of secondary recristalyzed orthopyroxene, clinopyroxene and phlogopite are weak, but correlated to the orthopyroxene CPO implies that mylonitization results from a later event, which affected locally the deep cratonic lithosphere. Based on microstructural and major and traces element geochemical data, we propose strain localization at high temperature assisted by fluids-magmas percolation that led to the temperature increase, the dislocation of orthopyroxene porphyroclast and the precipitation of secondary phase along the ultramylonite bands.