

## **Quantitative 3D measurement of ilmenite abundance in Alpe Arami olivine by confocal microscopy: Confirmation of high-pressure origin**

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### **ABSTRACT**

A critical aspect of the debate about the origin and conditions of metamorphism of the Alpe Arami (AA) peridotite is the disagreement over how much ilmenite is contained in the older generation of olivine and therefore how much TiO<sub>2</sub> might have been dissolved at high pressure and temperature. We have now determined quantitatively the 3-dimensional distribution of ilmenite in AA olivine by confocal laser scanning microscopy (CLSM). The CLSM measurements show an average concentration of 0.31 vol% of ilmenite in olivine, with individual grains containing up to 1.2 vol%. This translates into average and maximum concentrations of 0.23 and 0.9 wt% TiO<sub>2</sub> in olivine, respectively, and confirms the original estimation of maximum concentration of ~1 vol% TiO<sub>2</sub>. The vast majority of ilmenite in AA olivine is distributed randomly (although topotactically oriented) and, in all cases, is accompanied by chromite in a ratio of ~4:1. These observations are consistent with an origin of the ilmenite (and chromite) by exsolution from an olivine solid solution at  $P = 9\text{--}12$  GPa and temperatures above the stability field of titanian clinohumite, but are not consistent with suggested breakdown of titanian clinohumite. Combining these results with other recent findings suggests that exsolution followed deformation under relatively high fugacity of H<sub>2</sub>O, and that the high solubility of TiO<sub>2</sub> is probably explained by pressure-induced accommodation of Ti in the tetrahedral site of silicates.