

## **An experimental study of the external reduction of olivine single crystals**

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### **ABSTRACT**

Single crystals of San Carlos olivine in contact with graphite were annealed at  $P = 1$  bar,  $T = 1373$  K, for studying the reaction of extraction of (Fe, Ni) metal. Scanning electron microscopy and transmission electron microscopy were performed on samples recovered after the experiments. Precipitates of (Fe, Ni) and thin amorphous layer of silica were identified, exclusively on the surface of the single crystals. Mass balance indicates that volatilization of Fe, Mg, and Si is negligible under these conditions. The reaction can be summarized as:



which occurs at the crystal surface without affecting the interior of the crystal, except for an Fe<sup>2+</sup> and Mg<sup>2+</sup> compositional profile in the olivine matrix. These chemical profiles are consistent with measured values of Fe<sup>2+</sup>-Mg<sup>2+</sup> interdiffusion coefficients, in agreement with the fact that Si and O are relatively immobile in olivine under such conditions.

This study shows that annealing at relatively moderate temperature under reducing conditions can cause surface modifications and thus probably can strongly influence the surface evolution of planetary objects exposed directly to space environments (regoliths, surfaces of asteroids, or interplanetary dust particles).