

XRD AS A TOOL TO CONSTRAIN OLIVINE COMPOSITION: APPLICATIONS TO H- AND L-CHONDRITES.

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Introduction: Recent work by Bland et al. [1] and Menzies et al. [2] has sought to quantify modal abundance of chondrites using x-ray diffraction (XRD). This work utilized complex techniques involving a specialized X-ray detector (Position Sensitive Detector or PSD) that enabled simultaneous X-ray detection from 0° - 120° 2θ [1]. Olivine with different Fa contents appears to have slightly different XRD peak positions [3]. However, it is difficult to ascertain the exact relationship between Fa content and peak position using existing databases alone, as the data were not obtained with the same instruments or under the same conditions. We performed experiments on equilibrated (type 4-6) H- and L-chondrites to evaluate whether conventional XRD techniques using the same instrument and scanning conditions can be used to reliably infer olivine Fa content, and thereby to classify chondrites, as an alternative to the more time-consuming and expensive electron microprobe (EMP) technique.

Methods: Sample material was prepared by grinding with an agate rock grinder, and samples were sieved to less than 30 μm particle size. Powder specimens were scanned using default continuous settings on Portland State University's Phillips X'pert 3040 X-ray diffractor, using a 15 mm mask with scan settings of 0.5 seconds per 0.02° 2θ between 5° - 90° 2θ . Co K α radiation and a side loading, open top specimen holder were utilized for all scans. The Phillips X'pert Graphics and Identify software (version 1.2d) was then employed for normal peak fitting analysis for all minerals expected in an ordinary chondrite. 3 olivine peaks showing relatively little overlap with other phases were selected for further detailed analysis, to determine whether exact centroid position varied with average Fa content in olivine as determined by previous EMP analysis. 19 scans were performed under these conditions on a variety of H 4-6 and L 4-6 ordinary chondrites. We made multiple scans of the meteorites to obtain an estimate of the internal precision.

Results: We report a good correlation between peak position and Fa composition for the olivine peak located at $\sim 79.2^{\circ}$ - 79.5° 2θ . For this peak, we determined a correlation line with r^2 of ~ 0.85 , or ~ 0.89 if one apparently spurious data point is omitted. We observed no overlap in peak position between L and H type ordinary chondrites. Therefore, we can differentiate between the two types based on XRD data alone. Moreover, internal precision ($\sim 0.013^{\circ}$ 2θ) is found to be small compared to the difference in average peak position between H- and L- chondrites ($\sim 0.16^{\circ}$ 2θ). For equilibrated H- and L- type ordinary chondrites, we can obtain Fa composition to ± 1 mol % at 95 % confidence utilizing XRD. Thus, our results suggest that conventional XRD can be used to relatively quickly constrain olivine compositions in ordinary chondrites and possibly in other types of samples.

References: [1] Bland P.A. et al. 2004. *Meteoritics & Planetary Science* 39:3-16. [2] Menzies O.N. et al. 2005. *Meteoritics & Planetary Science* 40:1023-1042. [3] Deer W.A. et al. 1966. An Introduction to Rock Forming Minerals