SHOCK STAGE MEASUREMENT IN ORDINARY CHONDRITES AND ACHONDRITES BY IN-SITU MICRO-XRD. P.J.A. McCausland[1], R.L. Flemming[1] and M.R.M. Izawa[1] [1]Dept. of Earth Sciences, U. of Western Ontario, London, ON, Canada N6A 5B7 (pmccausl@uwo.ca).

Rationale: Shock metamorphism is a common feature in most meteorites and impact structure target rocks [1]. A widely used classification system of increasing shock stage from S1 to S6 in ordinary and carbonaceous chondrites [1,2] and E chondrites [3] is based on petrographic observations of olivine and pyroxene deformation features and textural relations such as the development of metal-bearing veins, local Fe-reduction in silicates and of maskelynite. Shock deformation of minerals produces streaks (mosaicity) rather than discrete spots in single-crystal X-ray diffraction patterns [4], representing the disruption of the crystal lattice into a mosaic of somewhat-rotated domains [5]. XRD mosaicity has been shown to correlate with increasing shock stage in pyroxenes from E chondrites [6]. Here we use *in situ* micro-XRD [5,6] to measure XRD mosaicity of olivine and pyroxene from ordinary chondrite slabs and thin sections of shock stages S1 to S5 and then extend the method to achondrites with qualitatively low to high shock.

Methods: Shock stage was established for ordinary chondrite polished thin sections by petrographic methods [1]. X-ray diffraction data were collected on polished thin sections and slab cut surfaces using a Bruker D8 Discover micro X-ray diffractometer (μXRD) at the University of Western Ontario [5], operated using CuKα radiation generated at 40 kV and 40 mA with a beam diameter of 500 μm. Diffracted X-rays were detected by a General Area Detector Diffraction System (GADDS). Two-dimensional GADDS images yield information in both the 2θ and chi (χ) dimensions, in which each lattice plane (hkl) will have a diffraction spot or streak lying along an arc in χ of radius $2\theta_{hkl}$. Peak intensity plotted as a function of 2θ gives a conventional powder diffraction pattern, used to assign the Miller index to the observed olivine and pyroxene diffraction lines, using the International Centre for Diffraction Data (ICDD) database. Additionally, for individual reflections we integrated narrow regions of 2θ as a function of χ angle, allowing examination of the peak shape and quantitative analysis of peak width along χ.

Results and Discussion: Olivine exhibits greater mosaicity in χ with increasing shock stage, ranging from <1° for the L3.8 (S1) chondrite NWA 2385 to >6.5° for the L5 (S5) NWA 1779. A slight broadening of the olivine peaks in 2θ was also observed with increased shock state, consistent with calibrated experimental studies on olivine [7]. These observations show that shock classification (and pressure calibration!) can be done using *in situ* XRD data from olivine and may be applied to achondrites as well. For example, a slab of the olivine shergottite SaU 008 exhibits mosaicity >5°, indicating that it has experienced shock stage S4-S5, with shock pressures in the range 20-45 GPa [1,7].

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References: [1] Stoffler, D., Keil, K. and Scott, E.R.D. (1991) *GCA 55*, 3845-3867. [2] Scott, E.R.D., Keil, K. and Stoffler, D. (1992) *GCA 56*, 4281-4293. [3] Rubin, A.E., Scott, E.R.D. and Keil, K. (1997) *GCA 61*, 847-858. [4] Horz, F. and Quiade, W.I. (1973) *The Moon 6*, 45-86. [5] Flemming, R.L. (2007) *Can. Jour. Earth Sci. 44*, 1333-1346. [6] Izawa, M.R.M, Flemming, R.L. and Banerjee, N.R. (2009) *LPSC XV*. [7] Uchizono et al. (1999) *Min. Jour. 21*, 15-23.