ALTERATION OF A MARTIAN IMPACT REGOLITH RECORDED IN NWA 8114.

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Introduction: NWA 8114 (a pair of NWA 7034 [1]) offers a unique opportunity to combine a detailed mineralogical study, together with ^{40}Ar-^{39}Ar dating of separated clasts. The aim of our study is to reveal the record of alteration in a martian regolith, and correlate mineralogical features such as veining and accretionary rims to radiometric ages.

Sample and Methods: Four polished sections of NWA 8114 were studied by SEM-EDX, EPMA and subsequently 5 wafers extracted by FIB-SEM, for TEM and EDX on a Jeol 2100, at UoL. The sections were also analysed at the I18 Beamline of the *Diamond* synchrotron, using Fe-K XANES to determine ferric contents, with the calibration of [2]. Four clasts were also separated from the bulk meteorite, analysed by SEM-EDX and fragments of them subsequently analysed with an Argus VI mass spectrometer, at SEAES, for Ar isotopes and halogens.

Results: We have studied alkali feldspar clasts including cryptoperthite, basaltic clasts with fine grained accreted rims and cpx and low-Ca pyroxene clasts, often with feldspathic rims. Feldspathic veins sometimes vein the pyroxene and basaltic clasts and are truncated by the rims.

Some of the pigeonite clasts, with bulk compositions $Wo_{12\text{-}18}En_{31\text{-}34}Fe_{47\text{-}56}$, and low-Ca pyroxene clasts $Wo_2En_{65\text{-}68}Fs_{29\text{-}33}$, when examined with TEM, are seen to have broken down to a submicron, granular mixture of iron oxide ~10-20% and an amorphous Al-silicate ~20%, with relict and recrystallised pigeonite or low-Ca pyroxene (<2.5% Wo) the remainder. Such alteration has not to date been seen in augite-dominated clasts which are $Wo_{42\text{-}46}En_{31\text{-}35}Fs_{19\text{-}26}$. Unaltered cpx-dominated clasts have negligible ferric iron contents but altered pigeonite and low-Ca pyroxene have $Fe^{3+}/Fe_{tot} \leq 25\%$.

Ar-Ar Dating. Three alkali feldspar clasts and one augite clast show a range of disturbed ages. When calculated from measured ^{40}Ar-^{39}Ar ratios, the pyroxene clast shows such ages ranging from 1100-1250 Ma, whereas the feldspar clasts show more varied values.

Discussion: The compositions of pyroxenes and exsolution lamellae suggest that the partial breakdown in many of those clasts took place with an upper limit of 900 ^{o}C. This alteration was associated with oxidation and may mark the presence of water within a high temperature, buried regolith blanket. Although this regolith contains ancient material e.g. with 4.4 Ga zircons [3], the Rb-Sr age for NWA 7034 of 2.7±0.6 Ga [4] and U-Th-He of 170 Ma [5] require late resetting events. Our Ar-Ar data are consistent with this and suggest that the oxidation and recrystallization of pyroxene at elevated temperatures took place much later than the magmatic formation of precursor basaltic and alkaline phases. Ar-Ar resetting events probably include the formation of accretionary rims as they postdate the veining seen within the clasts and thus formed at a relatively late stage in the evolution of the regolith breccia.

References: [1] Santos, A.R. et al. 2015, *GCA*, 157, 56-85. [2] Hicks L.J. et al. 2014, *GCA*, 136, 194-210. [3] Humayun, M. et al. 2013, *Nature* 503, pp 513-516. [4] Nyquist, L.E. et al. 2013, *Meteoritics & Planetary Science*, *48*, pp.A270–A270. [5] Cartwright, J.A. et al. 2013, *LPSC XLIV*, Abstract #2314.