INITIAL $^{53}Mn/^{55}Mn$ IN PLUTONIC ANGRITES NORTHWEST AFRICA 4590 AND 4801 BY ION PROBE

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Introduction: Ion probe analysis is an efficient technique for ^{53}Mn-^{53}Cr dating of meteorites that contain minerals with high Mn/Cr ratios [1]. Differences in initial $^{53}Mn/^{55}Mn$ ratio determined from isochron regression can be interpreted as an age by using $t_{1/2}$ = 3.7 Ma [2], as long as samples can safely be assumed to originate from the same isotopic reservoir. The ion-probe approach involves minimal sample consumption, such that rare and/or small meteorites with appropriate mineralogy (e.g. angrites) can still be analyzed when other techniques might be impracticable. Following previous investigations into the initial $^{53}Mn/^{55}Mn$ of strongly zoned olivine in quenched angrites D'Orbigny and Sahara 99555 [3], we have made measurements on unzoned olivine from plutonic angrites Northwest Africa (NWA) 4590 and 4801.

Methods: Since plutonic angrites have, relative to the quenched angrites, lower initial $^{53}Mn/^{55}Mn$, less grain-to-grain Mn/Cr variation, and generally lower Mn/Cr, we have modified our previous method to achieve precision on Cr isotopic analyses at the level of a few permille. Sensitive High-mass Resolution Ion Micro-Probes (SHRIMP-II and -RG) were used with high primary beam currents (17-53 nA unfiltered oxygen beam) and long counting times using an electron multiplier to improve precision on $^{53}Cr/^{52}Cr$. The $^{55}Mn^+$ beam was correspondingly intense, and was measured with a Faraday cup either simultaneously with $^{52}Cr^+$ counting (SHRIMP-II multi-collector) or at another magnet setting (SHRIMP-RG single collector). Inter-element matrix effects were corrected with Mn-Cr relative sensitivities determined in synthetic Mg-Fe-Ca olivine [3].

Results: Olivine from NWA 4590 exhibits exsolution of subcalcic kirschsteinite from Mg-Fe olivine, giving Mn/Cr of 500-5000 and initial $^{53}Mn/^{55}Mn$ of 1.04×10^{-6} (accurate to within 15%). Olivine from NWA 4801 has uniform major element composition around Fo_{55}, but Mn/Cr varies from 200-800 between grains; initial $^{53}Mn/^{55}Mn$ was found to be 1.4×10^{-6} (accurate to within 50%).

Conclusions: Our result for NWA 4590 is in agreement with and of comparable precision to previous inductively coupled plasma mass spectrometry (ICP-MS) results [4]. Our NWA 4801 isochron is less precise, but is also in agreement with ICP-MS [4], as well as previous thermal ionization mass-spectrometry results [5]. These results confirm the broadly bimodal age populations in angrites, expressed in quenched and plutonic rocks. Our determination of initial $^{53}Mn/^{55}Mn$ in NWA 4590 and 4801 shows that Mn-Cr dating of rare and/or small plutonic angrites by ion-probe is a viable option in situations where bulk methods might be prohibitively destructive.

References: [1] Sugiura N. et al. 2005. *Earth Planets Space* **57**:e13-e16. [2] Honda M. & Imamura M. 1971. *Physical Review C* **4**:1182-1188. [3] McKibbin S. J. *et al.* 2008. Abstract #5132. 71st Annual Meteoritical Society Meeting. [4] Yin Q.-Z. *et al.* 2009. Abstract #2060. 40th Lunar and Planetary Science Conference. [5] Shukolyukov A. *et al.* 2009. Abstract #1381. 40th Lunar and Planetary Science Conference.