DEVELOPMENT OF ROUTINE MULTI-COLLECTION Ni ISOTOPIC ANALYSIS OF Fe-RICH SILICATES BY ION MICROPROBE

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Introduction: Iron-60 decays to ^{60}Ni with a half-life of 2.6 Myr, providing sufficient time resolution to date early solar system events. Its presence in the early solar system has been demonstrated and estimates of its initial abundance have been made by measurements of various meteorites [1-4]. We are developing a protocol for routine multicollection ^{60}Fe-^{60}Ni measurements using the Cameca ims 1280 ion microprobe at the University of Hawaii. Difficulties in controlling interferences were reported in [5]. We have significantly reduced the interferences, and we now have the first data using the new protocol.

Technique: Iron and nickel isotopes were measured as positive ions using an $^{16}O^-$ beam. A mass resolving power (MRP) of ~5500 using a multicollector exit slit of 250 μm resolves all major interferences except ^{60}NiH. A 20eV energy offset reduced the major interferences and effectively eliminated the complex molecular interferences identified by [5]. ^{60}Ni, ^{61}Ni, and ^{62}Ni were measured concurrently on electron multipliers (EMs), followed by field jumps to monitor the interferences using the EMs and to measure ^{57}Fe using a Faraday cup. Measurements were corrected for the tails of the interferences and for detector background. Instrumental mass fractionation for ^{60}Ni/^{62}Ni was corrected externally by comparison with standards, although ^{61}Ni/^{62}Ni was monitored to assure that the fractionation was stable.

Results: This protocol gave stable and reproducible results on standards. Nickel metal, two pyroxenes, and San Carlos olivine plotted along a mass-fractionation line. On a ^{60}Ni/^{61}Ni vs ^{61}Ni/^{62}Ni plot, data for Semarkona pyroxene chondrule DAP1 should plot on a vertical array, if mass fractionation is constant and DAP1 contains excess ^{60}Ni from ^{60}Fe decay. This was generally true except that ^{61}Ni/^{62}Ni tended to increase as count rate decreased (Fe/Ni ratio increased). We investigated several possible reasons. ^{60}NiH was measured at high MRP on several spots that gave high ^{61}Ni/^{62}Ni and on pristine spots and was found not to explain the shifts. We compared detector efficiency as a function of count rate by measuring ^{61}Ni/^{62}Ni with different sets of EMs and found that the C EM, where ^{61}Ni was measured, appears to have an extra noise component not seen when there is no signal on the EM. An empirical correction based on these tests eliminated the shift in ^{61}Ni/^{62}Ni, and the average corrected ^{61}Ni/^{62}Ni for DAP1 was within errors of the mean for the standards. This gave us confidence to use an external fractionation correction.

The isochron plot for DAP1 gives a $(^{60}Fe/^{56}Fe)_0$ ratio of $(2.15\pm0.72)\times10^{-7}$, within the range reported for other Semarkona and Bishunpur chondrules using monocollection and higher MRP [6,7]. The uncertainty is smaller than for all but the first chondrule we measured, which has been measured multiple times [6].

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