EXTINCT ^{60}FE IN THE EUCRITE NWA 4523

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Introduction: ^{60}Fe ($T_{1/2}$=1.49 Ma) is a key to constrain the origin of short-lived radioactive nuclides in the early Solar system (ESS) since it is the only one (among ^{7}Be, ^{10}Be, ^{26}Al, ^{36}Cl, ^{41}Ca and ^{53}Mn) which, because of its neutron-rich nuclei, cannot be anything else than a stellar product injected from a nearby dying star [1]. Several recent studies have confirmed the presence of ^{60}Fe in the ESS with a ^{60}Fe/^{56}Fe ratio of $\approx 5(\pm 5)\times 10^{-7}$ [2,3]. However, because of Ni nucleosynthetic anomalies, the ^{60}Fe/^{56}Fe at the time of formation of Ca-Al-rich inclusions (CAIs) is difficult to constrain (and could be as high as $\approx 5\times 10^{-6}$) [4]. In addition, the initial distribution of ^{60}Fe in the ESS is a matter of debate [5]. These are critical issues, especially when considering the recent determination of the high level of galactic background for ^{60}Fe : ^{60}Fe/^{56}Fe $=1.4\times 10^{-7}$ [6].

In order to make progress with our understanding of the distribution of ^{60}Fe in the ESS we have searched for ^{60}Ni radiogenic excesses in the eucrite breccia NWA 4523 recently found in Sahara. NWA 4523 contains two types of clasts embedded in a fine grained recrystallized matrix: medium grained ophitic/subophitic clasts and fine-grained clasts [7]. The medium-grained clasts (grain size between 1-2 mm) display a subophitic texture and are composed of plagioclases, pyroxenes (pigeonitic core and augitic rim), silica, ilmenite, chromite crystals, and a recrystallized mesostasis containing among others magmatic troïlite crystals of 10-50µm.

Results and implications: The Ni isotopic compositions and the Fe/Ni ratios were measured with the CRPG-CNRS ims 1270 ion microprobe in ≈15 different troïlite grains. The radiogenic ^{60}Ni excesses were calculated from the measurement of three Ni isotopes (^{60}Ni, ^{61}Ni, ^{62}Ni) at a mass resolution of ≈ 7000. The troïlite crystals have low Ni contents with ^{56}Fe/^{61}Ni of $2(\pm 1)\times 10^{6}$ and show ^{60}Ni excesses positively correlated with the Fe/Ni ratio indicating a ^{60}Fe/^{56}Fe of $\approx 7\times 10^{-7}$ at the time of isotopic closure for troïlite in NWA 4523. Because sulfides are the major repository of Ni in NWA 4523, it is difficult to envisage how secondary processes could have altered the Fe/Ni ratios in a way to produce apparent high ^{60}Fe/^{56}Fe ratios. Work is in progress to look for the presence of ^{60}Ni excesses in the pyroxenes associated with the sulfides but peak tailing of the interferences at masses 61 and 62 make the measurement of the ^{60}Ni excesses difficult.

The high initial ^{60}Fe/^{56}Fe ratio found in NWA 4523 is higher than that found in ferromagnesian chondrules from ordinary chondrites [2] but similar to that reported for troïlite from Semarkona [3]. It would be consistent with the upper limit of $1.6\pm 0.5\times 10^{-6}$ initially proposed from CAIs for the ^{60}Fe/^{56}Fe in the ESS [8].

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