COSMOGENIC NUCLIDES IN IRON METEORITES: CHALLENGING CANYON DIABLO

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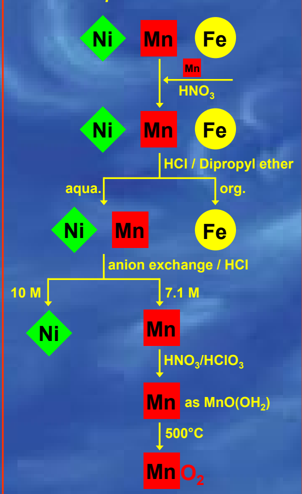
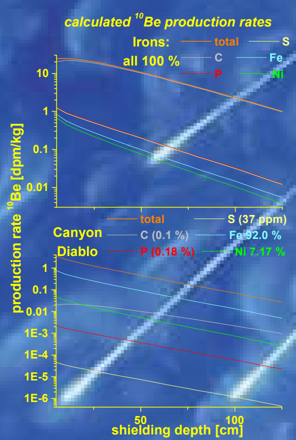
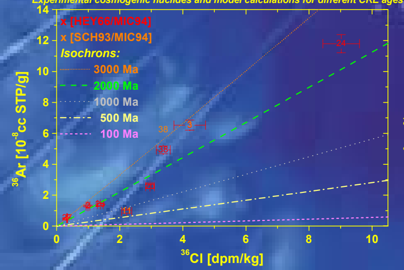
Project:

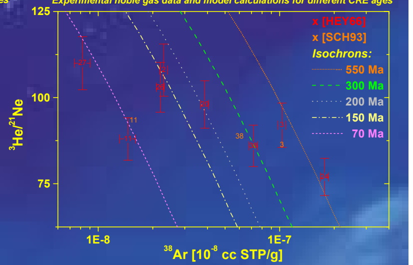
- 8 samples from a suite of 56 Canyon Diablo fragments from known locations
- well-characterized samples: stable and lighter radionuclides already published [HEY66,MIC94]
- here: first AMS-^{53}Mn depth-profile of an iron meteorite (first stony, see [MER97])

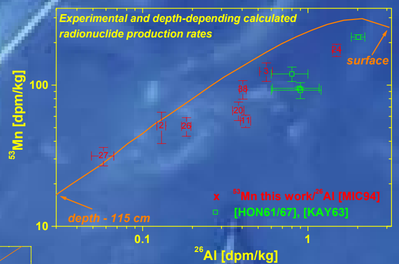
Chemical separation

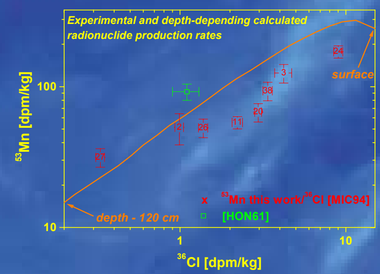


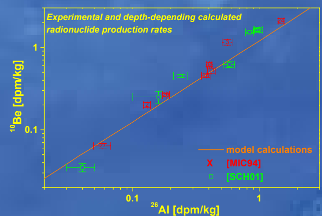












^{53}Mn AMS measurements @ Munich

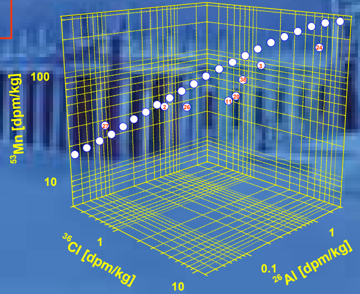
(for details see [KNI00])

sample form	$MnO(OH)_2$
mixed with	-
sample holder	Cu
extraction as	MnO^-
charge state	11+
ion energy	160 MeV
measured ratios	7E-10 - 4E-9
background	3E-14
transmission	~ 3 %
standard	$^{51}V(\alpha,2n)^{53}Mn$

Data for model calculations

(for details see [LEY00a/b])

J_0	4.36 $cm^{-2}s^{-1}MeV^{-1}$
M	550 MeV
σ	[MER00,MIC97]
Φ	[MAS99,SCH99]
chemical comp.	[BUC75,MET99]



Experimental (^{53}Mn this, ^{26}Al/^{36}Cl [MIC94]) and calculated depth-depending radiouclide production rate

Results of AMS measurements for Canyon Diablo samples

Sample#	II	III	11	20	24	26	27	38
$^{53}Mn/^{55}Mn$ [E-9]	0.65 ± 0.16	2.60 ± 0.39	1.31 ± 0.13	1.50 ± 0.23	4.10 ± 0.41	1.07 ± 0.16	0.69 ± 0.10	2.31 ± 0.35
^{53}Mn activity [dpm/kg]	51 ± 13	124 ± 19	55.1 ± 5.5	65.4 ± 9.8	175 ± 18	50.6 ± 7.6	31.2 ± 4.7	93 ± 14
^{53}Mn production rate* [atoms/min·kg]	51 ± 13	125 ± 19	55.7 ± 5.6	66.0 ± 9.9	177 ± 18	51.1 ± 7.7	31.5 ± 4.7	94 ± 14

#sample numbers used by [HEY66]; II and III refer to the Canyon Diablo 2 and 3 meteorites respectively.
*corrected for terrestrial age of 49 ka [SUT85]

Conclusions:

- Because of the complex exposure history of Canyon Diablo
  - ⇨ the commonly used combination of radionuclide/stable noble gas nuclide should NOT be used to determine neither CRE ages nor terrestrial ages!
  - ⇨ noble gas ratios like $^3He/^{21}Ne$ or $^4He/^{21}Ne$ should NOT be used as shielding indicators!
- lighter radionuclides should be used with highest precaution due to strong dependence of chemical inhomogeneity as shielding or terrestrial age indicator!
- combination of heavier radionuclides, e.g. ^{41}Ca, ^{53}Mn, ^{59}Ni, ^{60}Fe most reliable as shielding or terrestrial age indicator!
- Canyon Diablo is an ideal object to test the quality of model calculations of radionuclides in iron meteorites, but difficult for noble gases!
- Improvement on model calculations is still necessary (especially for heavier nuclides)!

Acknowledgements:

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