The s-element evolution in the Galactic disc. The role of open clusters and the new s-process scenario

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GREAT-ESF Workshop
"The metallicity distribution in the Milky Way discs"

We analyzed: 18 open clusters with
[Fe/H] = [-0.3;0.4]
Age = [0.1;5] Gyr

On average 5 stars per cluster. Dwarf+RGB stars. No AGB

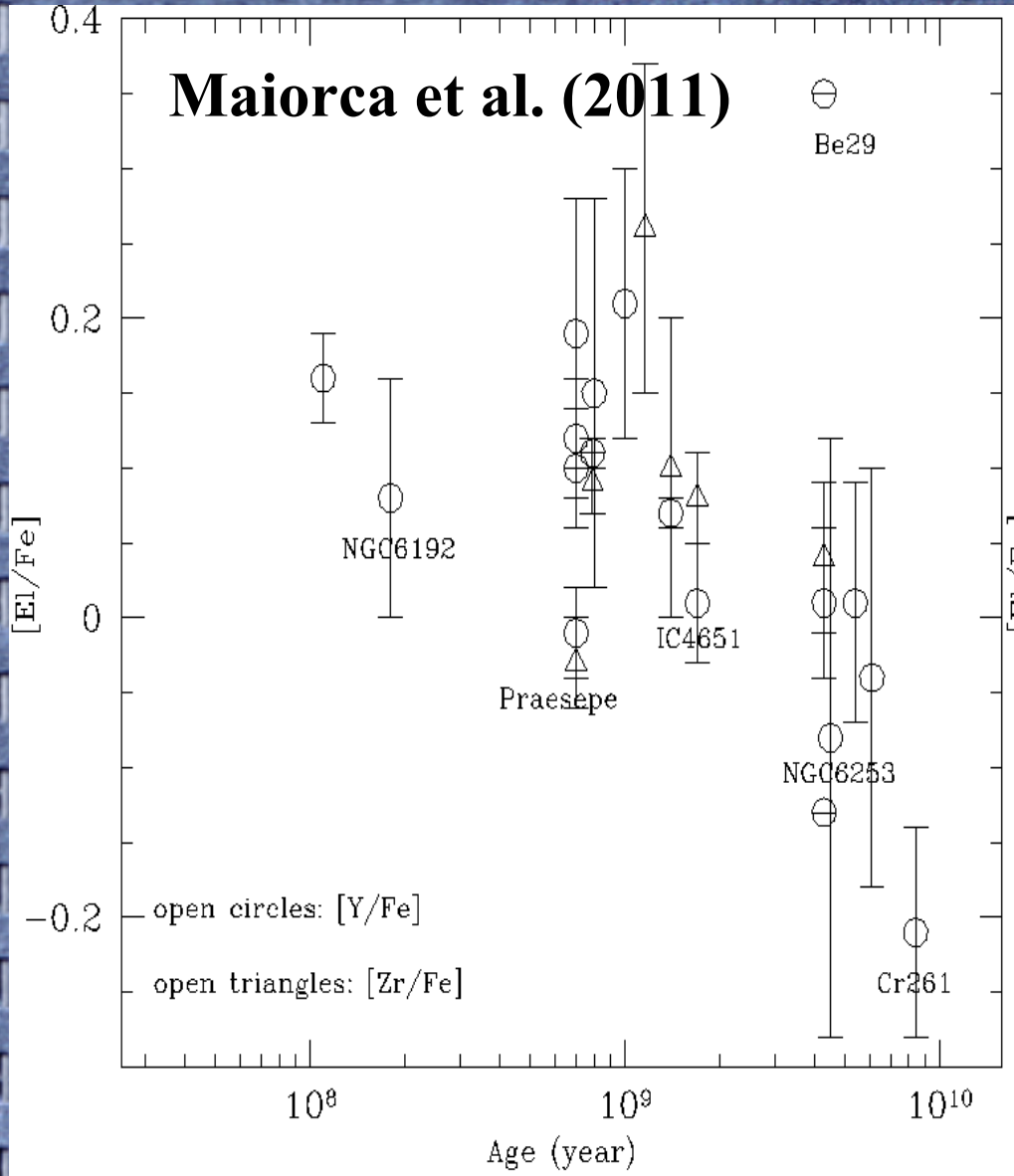
Stellar spectra collected with the UVES spectrograph at VLT

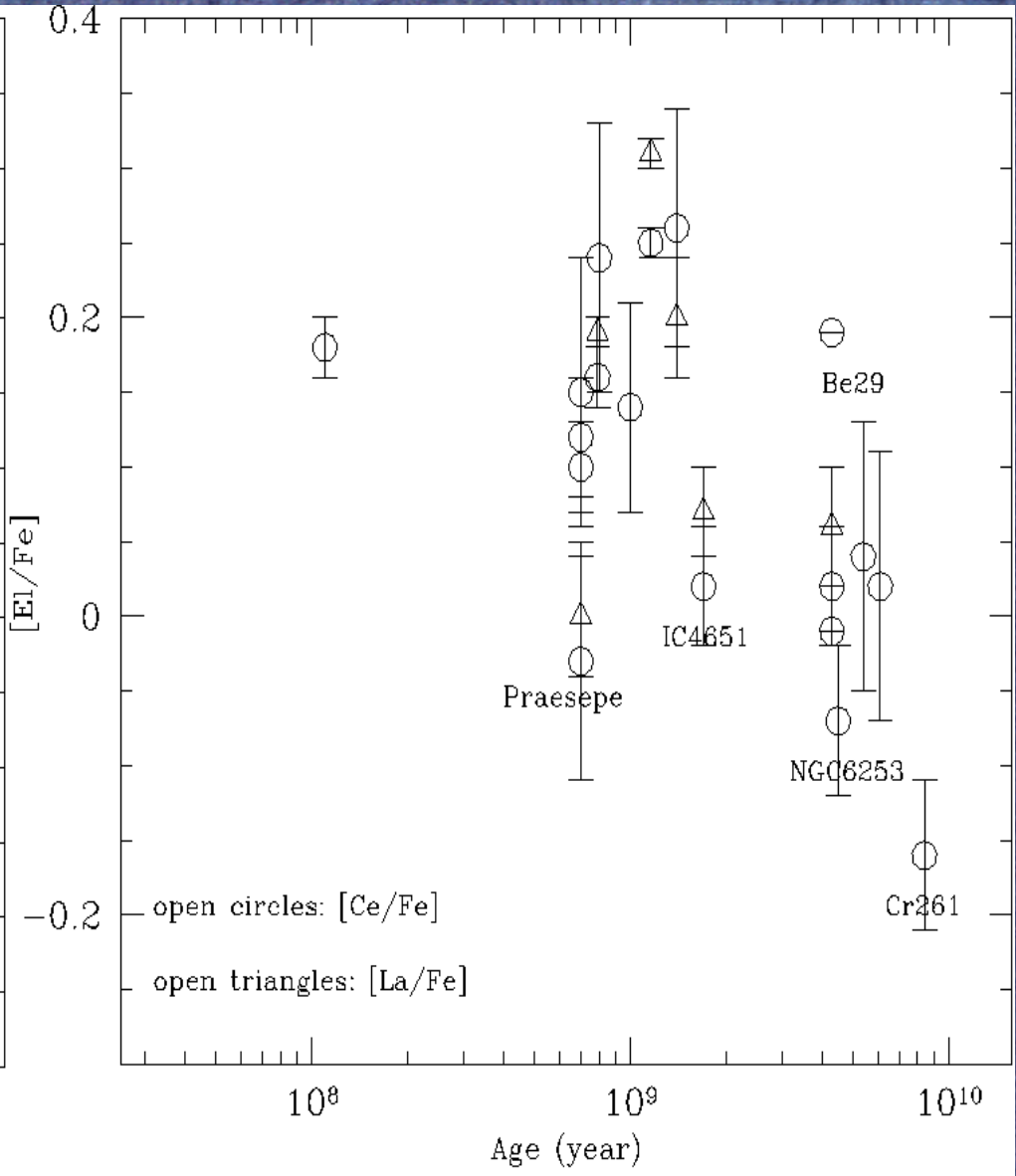
New atomic parameters from Sneden and Lawler's works

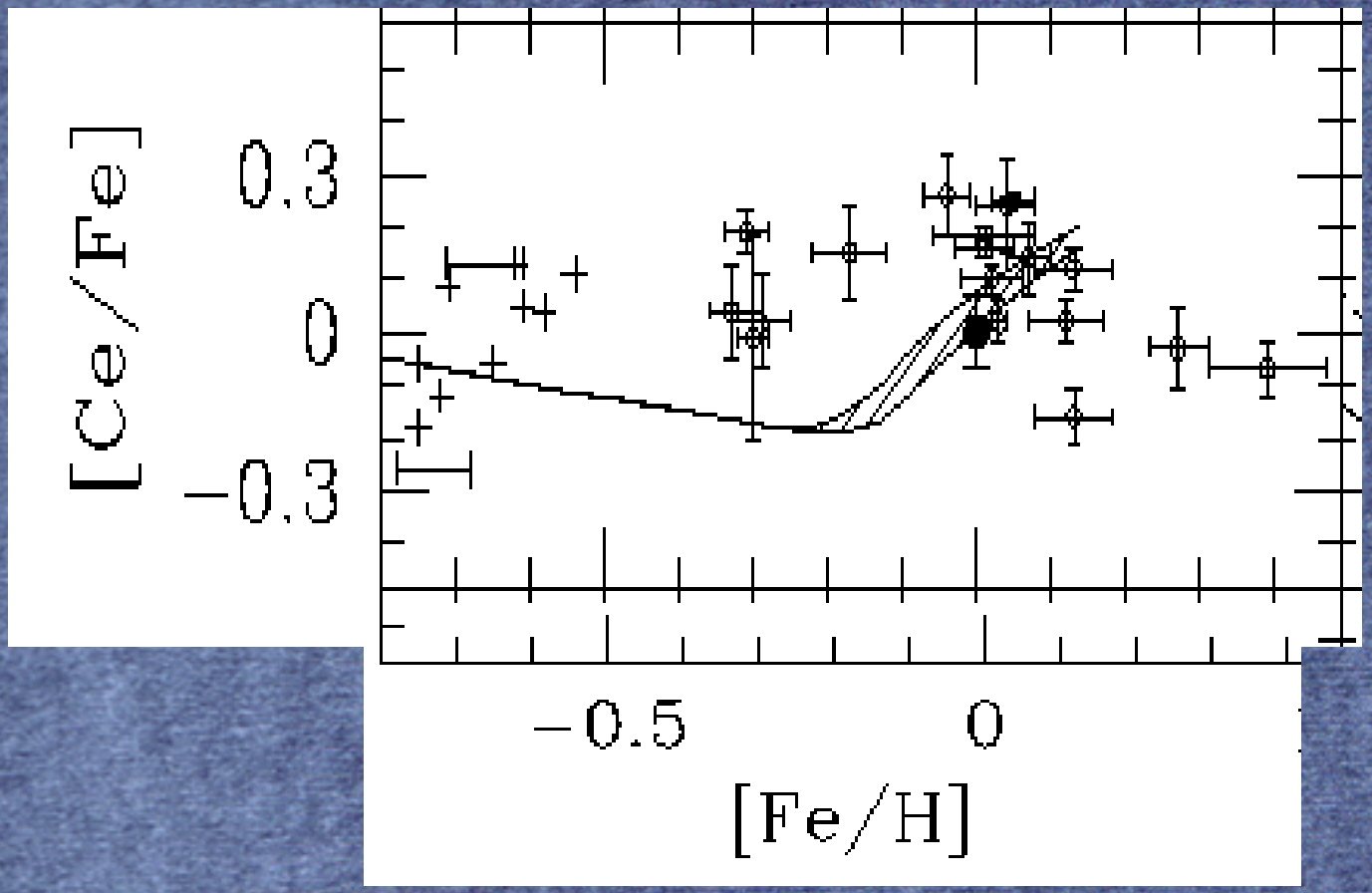
EWs measurements+ MOOG spectrocode

Homogeneous sample analyzed in a homogeneous way

s-elements in the thin disk: measurements from Open Clusters

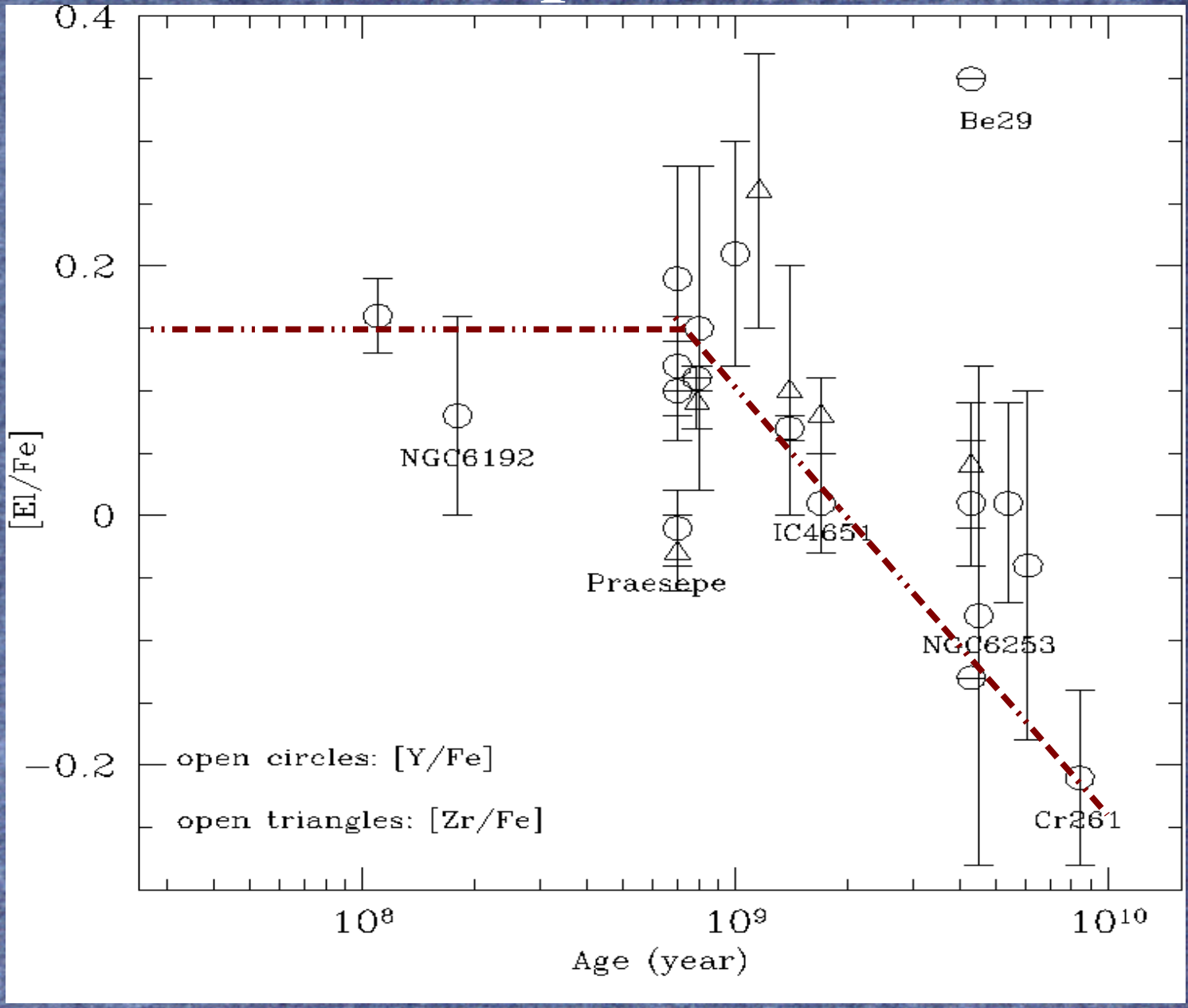





[Ce/Fe]
0.3
0
−0.3
−0.5
0
[Fe/H]

s-elements in the thin disk: measurements from Open Clusters

s-elements in OCs younger than ~1 Gyr are systematically enriched with respect to the solar abundances by about 0.2 dex

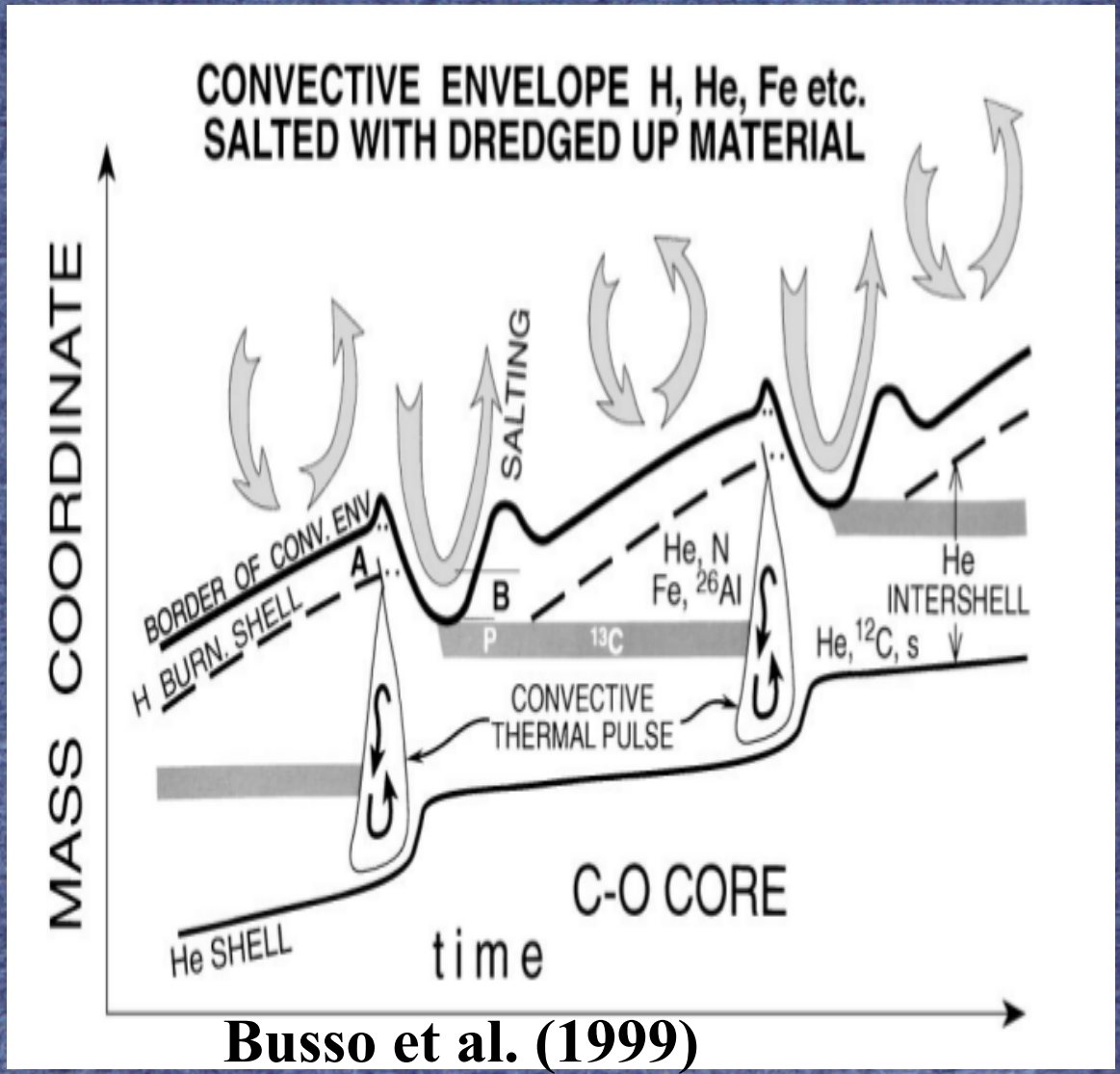


s-process nucleosynthesis

s-process from 13C burning depends on:

1) the 13C-pocket mass

2) the 13C mass fraction inside the pocket



Busso et al. (1999)

Chemical evolution with standard 13C-pocket: ingredients

Stellar mass range =]3;10]Msun

IMS from Serminato et al. 2009 (case ST-IMS)

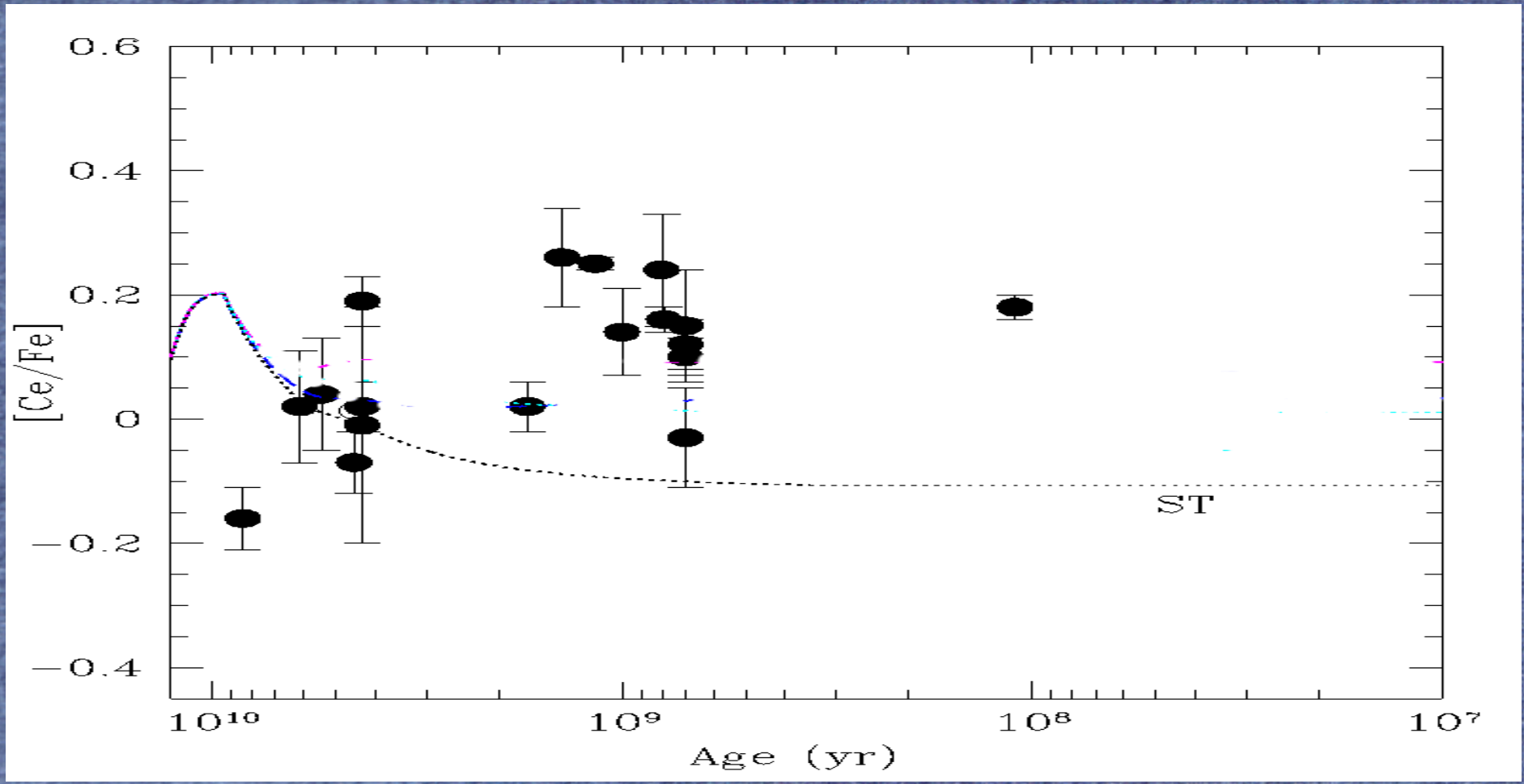
Weak component from Pignatari et al. 2010

Stars with [1.3-3]Msun
15 bins inside the GCE

Stellar metallicity range Z = [2e-3;24e-3]
7 bin inside the GCE

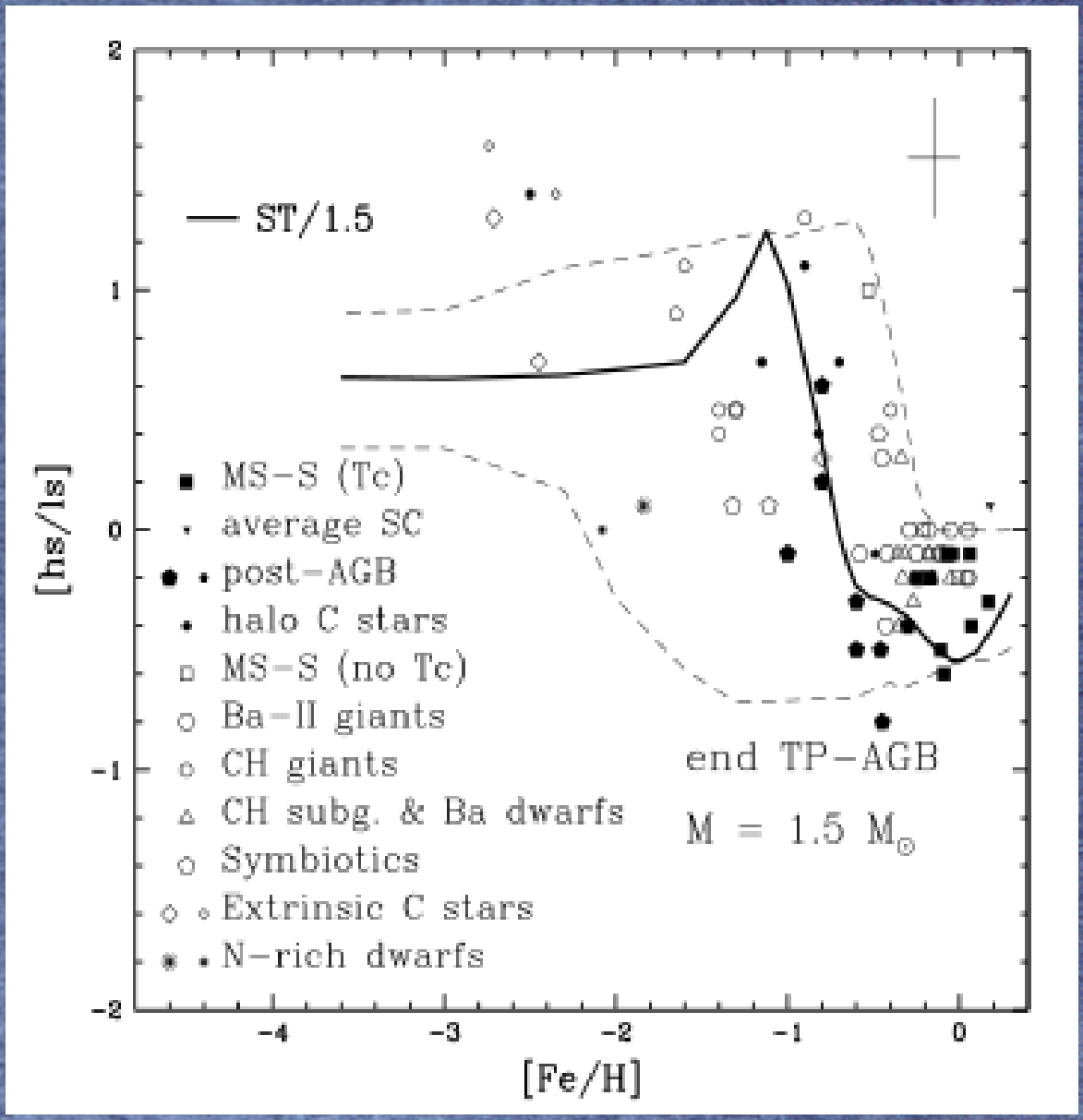
ST => 13C-pocket:
1) mass = 1e-3Msun
2) total 13C mass inside the 13C-pocket = 3e-06 Msun (very close to Travaglio et al. 2004)

Chemical evolution with standard 13C-pocket: results



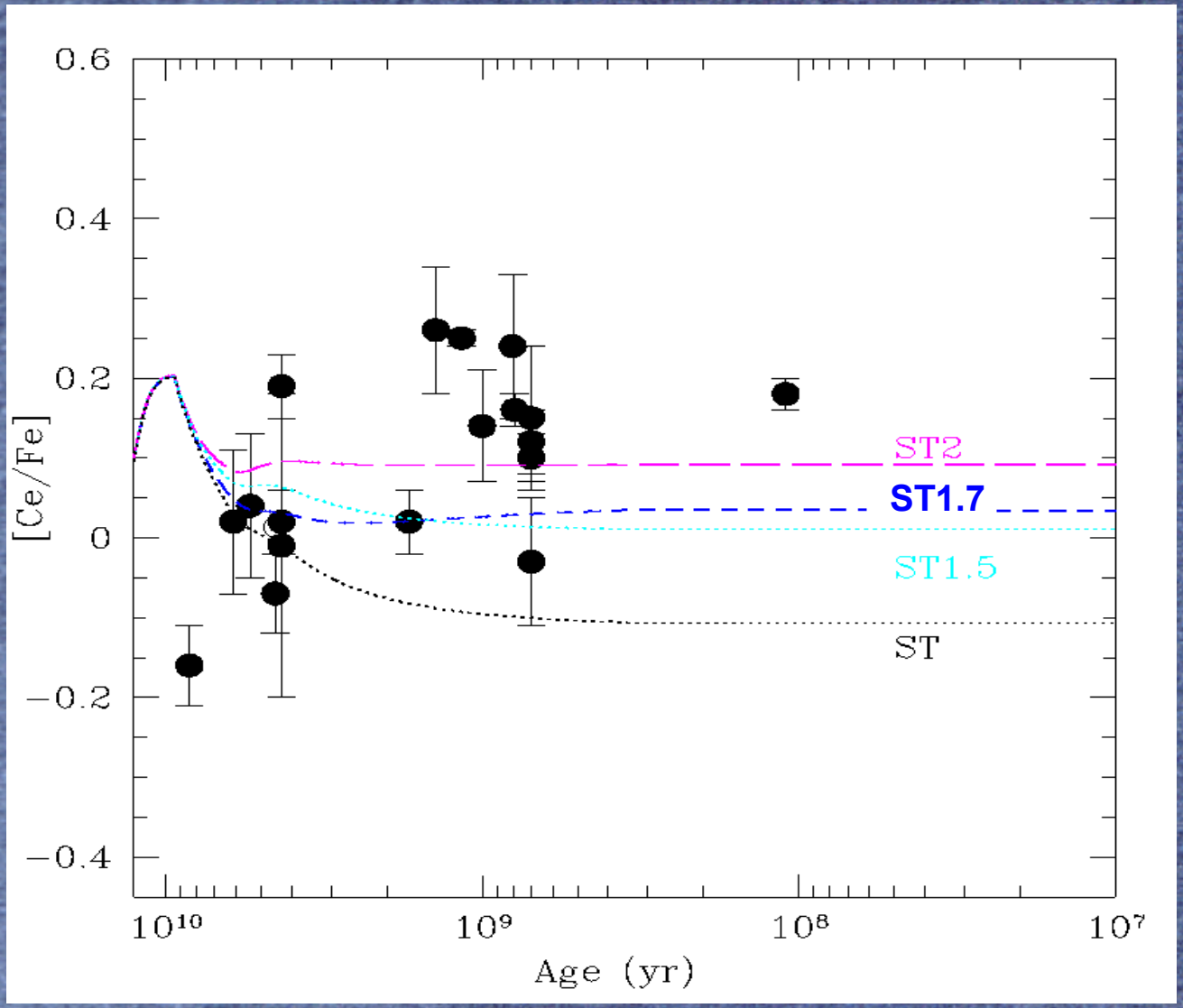
This is so not only for light s-elements but also for heavy ones. We need more neutrons

(not) New calculations: [1.5-3]Msun



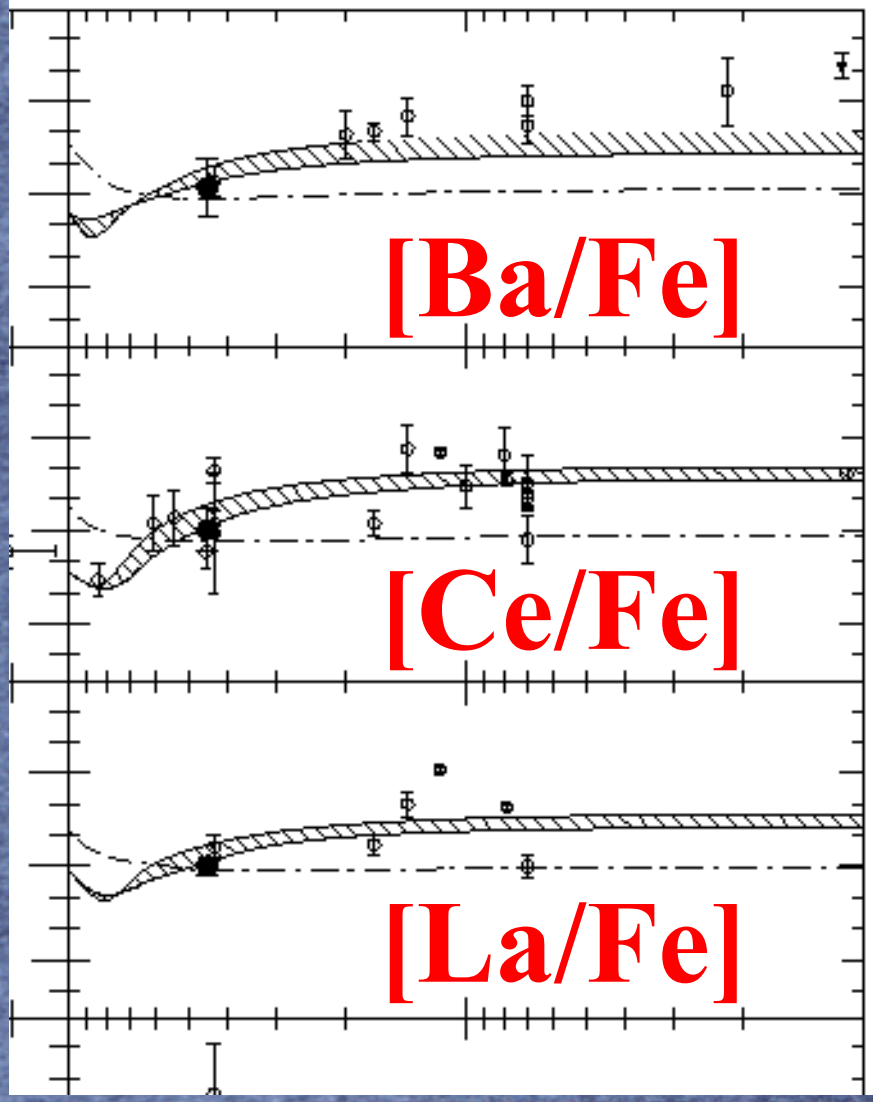
Good agreement with observations of s-elements in AGB stars (Busso et al. 2001)

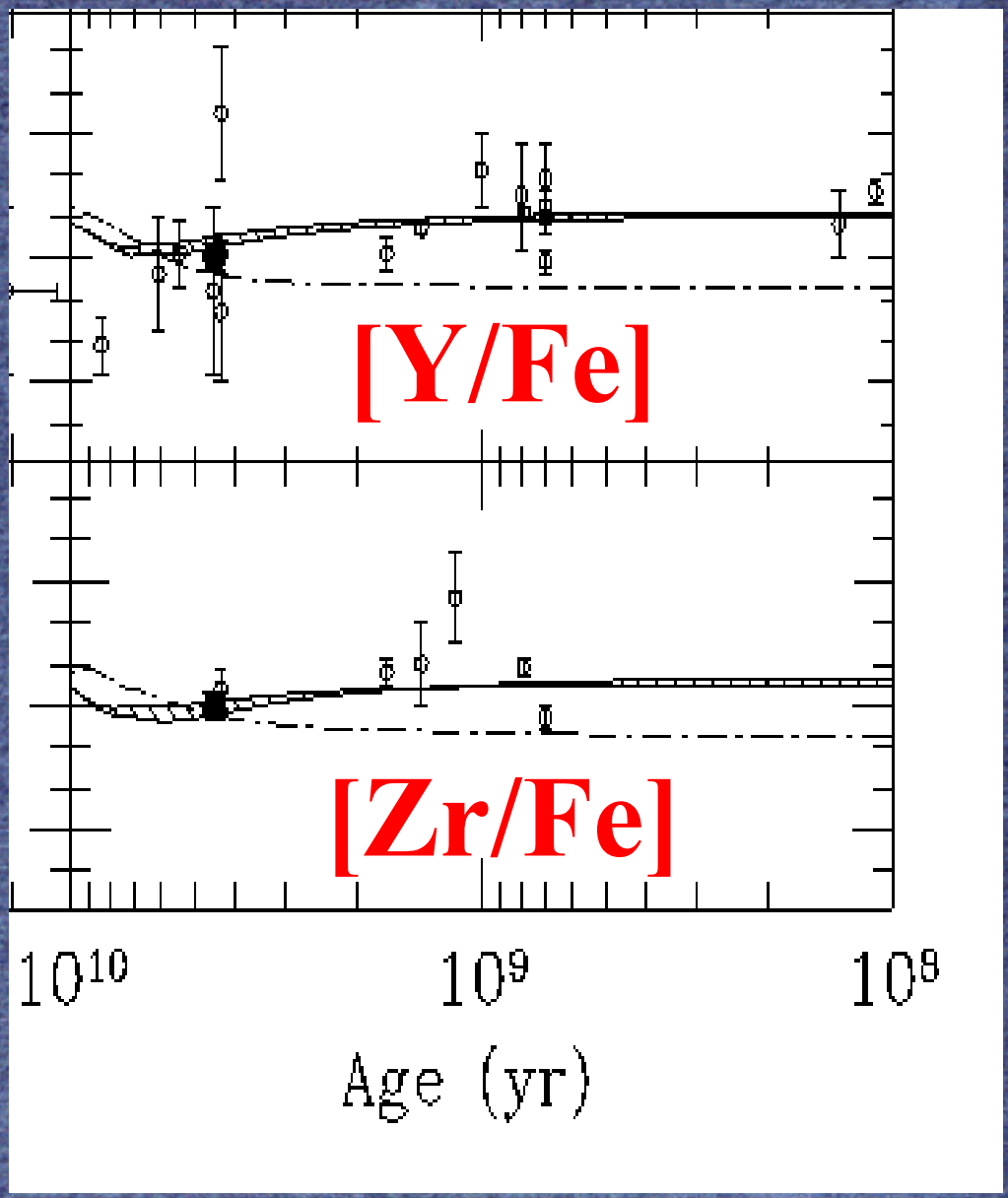
New calculations: M<1.5 Msun



Enhancing the X(13C) mass fraction inside the 13C-pocket

New calculations: M<1.5 Msun





Enlarging the 13C-pocket mass by a factor of 4

New solar s-process distribution

Table 1

Percentage Contributions to Solar Heavy Elements

(Galactic Chemical Evolution Estimates)

Element	This work: LMS	This work: non-LMS	Previous total (no LEPP) †	Literature: non-LMS (no LEPP) ‡
Yttrium	89 ± 1	10-12	62	up to 15 [4(r); 7(weak); 4(IMS)]
Zirconium	87 ± 2	11-15	55	up to 16 [10(r); 3(weak); 3(IMS)]
Barium	92 ± 3	5-11	–	13(r)
Lanthanum	85 ± 3	12-18	–	21(r)
Cerium	94 ± 4	2-10	–	15(r)

† Reference: Travaglio et al. (2004); ‡ references: Bisterzo et al. (2010); Serminato et al. (2009)

Percentage of solar s-only nuclei

(Galactic Contribution from LMS)

Isotope	Our range (LMS only)	Reference (31)
^{100}Ru	93 ± 2	95
^{110}Cd	97 ± 2	97
^{124}Te	91 ± 3	91

CONCLUSIONS

- s-elements in young (~1Gyr or less) galactic Open clusters are overabundant with respect to the Sun by about 0.2 dex
- GCE models can reproduce this growth assuming the Standard 13C-pocket in stars with [1.5-3] Msun and an extended, IN MASS, 13C-pocket for stars with M < 1.5 Msun
- The same prescriptions lead to a solar s-process distribution in agreement with observations without the solar-LEPP requirement.

Yields:
1.4 Msun vs 2 Msun