Rediscovering our Galaxy
Proceedings IAU Symposium No. 334, 2017
C. Chiappini, I. Minchev, E. Starkenburg
& M. Valentini, eds.

doi:10.1017/S174392131700816X

Elemental high-precision abundances as function of stellar ages: Constrains on the Galactic chemical evolution

Marcelo Tucci Maia

Laboratorio Nacional de Astronomia
Rua dos Estados Unidos 154, Itajuba, 37504-364 Minas Gerais, MG, Brazil
email: mmaia@lna.br

Abstract. Solar twins are a special group of stars that have spectra and stellar parameters very close to the Sun. Also having mass around 1 solar mass and roughly solar chemical composition, these stars follow a similar evolutionary path to the Sun, from the zero age main sequence to the end of their lives. Additional to that, the similarity between themselves permit us to obtain high-precision differential abundance and thus, very precise atmospheric parameters that allows a reliable estimation of their ages using the traditional isochronal method. Taking advantage of this very restrict group of stars we can better understand the effects of nucleosynthesis of chemical elements throughout the Galaxy and with this, finding constrains for its evolution.

Keywords. stars: abundances, Galaxy: evolution

1. Introduction

Solar twins are stars that are very similar to the Sun, which permit us to perform of an differential analysis and achieving high-precision abundances determinations of about 0.01 dex. Such precision allow us to derive very reliable stellar age. Thus, we can take advantage of this very special group of stars to better understand the yields of various elements throughout the Galaxy.

We complement the results of Spina, Meléndez, Ramírez, *et al.* (2016) and Nissen *et al.* (2015), (with data from UVES and HARPS, repectively), by performing an in-depth analysis with high-precision abundances, using HDS spectra (Noguchi, Aoki, Kawanomoto, *et al.* (2002)) for 31 elements.

Our sample have 7 solar twins in addition to those from Spina, Meléndez, Ramírez, *et al.* (2016) and Nissen *et al.* (2015) with stellar ages spanning from 0.7 to 10 Gyr, making 36 stars in total.

The HDS stars have very high-resolution spectra (R $\sim$ 90000 and $\sim$ 155000 for the blue and red arm respectively) and high S/N ratio ($\sim$200 and $\sim$ 1000 around 330 nm and 650nm respectively). The high-quality data and the great spectral coverage permitted us to analise elements that were not studied in those previous works, like N, Zr, and Ag.

2. Results

On Figure 1 we show part of our results with the abundances of [C/Fe], [O/Fe], [N/Fe], [Na/Fe], [Mg/Fe], [Al/Fe], [Si/Fe], [S/Fe] and [Ca/Fe] as function of stellar age, whereas Table 1 shows the parameter of the linear fit for all the 31 elements.

Table 1. Parameters from the linear fitting.

Element	a [dex]	b [dex.Gyr^{-1}]	σ [dex]	Element	a [dex]	b [dex.Gyr^{-1}]	σ [dex]
C	-0.110 ± 0.005	0.015 ± 0.001	0.028	Cu	-0.096 ± 0.006	0.017 ± 0.001	0.029
O	-0.071 ± 0.004	0.012 ± 0.001	0.031	Zn	-0.069 ± 0.004	0.011 ± 0.001	0.026
N	-0.026 ± 0.012	0.002 ±0.003	0.014	Y	0.137 ± 0.009	-0.032 ± 0.002	0.026
Na	-0.069 ± 0.003	0.008 ±0.001	0.032	Ba	0.174 ± 0.008	-0.029 ± 0.001	0.038
Mg	-0.036 ± 0.005	0.009 ±0.001	0.016	La	0.160 ± 0.010	-0.026 ± 0.002	0.037
Al	-0.073 ± 0.005	0.016 ±0.001	0.022	Ce	0.132 ± 0.007	-0.020 ± 0.001	0.039
Si	-0.022 ± 0.003	0.004 ±0.001	0.009	Nd	0.109 ± 0.015	-0.016 ± 0.002	0.039
S	-0.049 ± 0.007	0.006 ±0.001	0.018	Zr	0.121 ± 0.029	-0.027 ± 0.005	0.033
Ca	0.020 ± 0.003	-0.001 ±0.001	0.010	Sr	0.115 ± 0.016	-0.024 ± 0.003	0.023
Sc	-0.036 ± 0.004	0.010 ± 0.001	0.020	Ru	-0.013 ± 0.012	0.001 ± 0.004	0.036
Ti	-0.013 ± 0.004	0.006 ± 0.001	0.012	Rh	-0.019 ± 0.011	0.011 ± 0.003	0.013
V	-0.015 ± 0.004	0.002 ± 0.001	0.016	Pd	-0.010 ± 0.016	-0.006 ± 0.003	0.019
Cr	0.012 ± 0.003	-0.002 ± 0.001	0.007	Ag	-0.012 ± 0.009	-0.002 ± 0.002	0.005
Mn	-0.012 ± 0.003	-0.002 ± 0.001	0.016	Eu	0.087 ± 0.008	-0.008 ± 0.002	0.033
Co	-0.088 ± 0.009	0.023 ± 0.002	0.051	Pr	0.064 ± 0.010	-0.014 ± 0.002	0.011
Ni	-0.047 ± 0.003	0.005 ± 0.001	0.019				

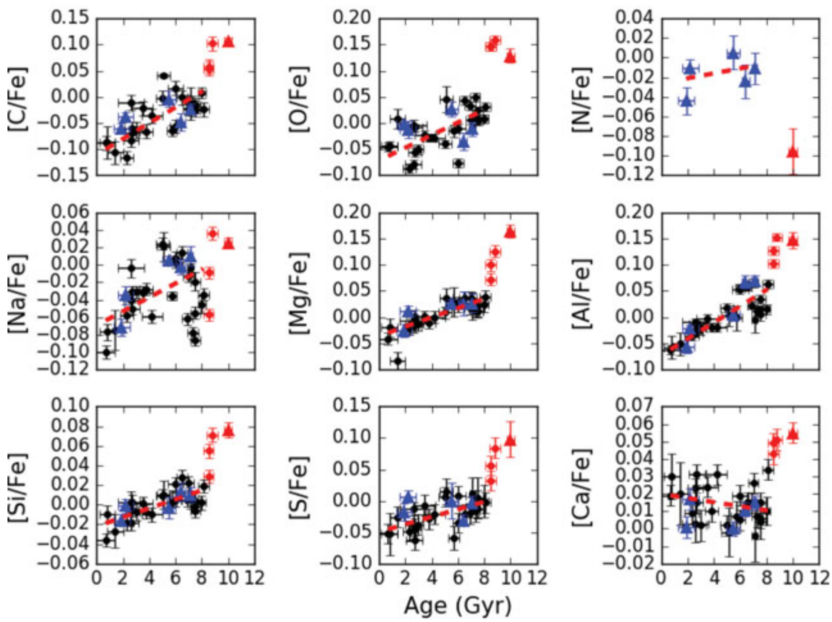

Figure 1. [X/Fe] ratios of the elements as function of stellar ages for 36 solar twins. Plotted as solid circles are the measurements taken from Nissen (2015), Nissen (2016) and Spina *et al.* (2016), while the solid triangles represents the measurements from this work. The red points represents thick disk stars. The red dashed line is the linear fit of the sample and its parameters as listed in Table 1.

This is a very important study that have meaningful implications not only in Galactic chemical evolution, but also for dating exoplanet host stars, studying stellar evolution effects and different studies of stellar populations.

References

Nissen, P. E. 2015, *AA* 579, A52

Noguchi, K., Aoki, W., Kawanomoto, S., Ando, H., Honda, S., Izumiura, H., Kambe, E., Okita, K., Sadakane, K., Sato, B., Tajitsu, A., Takada-Hidai, T., Tanaka, W., Watanabe, E., Yoshida, M. 2002,*PASJ* 54, 855

Spina, L., Meléndez, J., & Ramírez, I. 2016, *AA* 585, A152