Chemical Abundances in the Universe: Connecting First Stars to Planets
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Abundance distribution functions for nearby late-type dwarfs

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Abstract. A major role to the understanding of the chemical evolution of the Galaxy is played by studies of stellar chemical abundance distribution. In the last years, there has been an increase in the number of spectroscopic surveys of late-type stars. Classical problems on the chemical evolution of the Galaxy, such as the G dwarf problem and the age-metallicity relation, can be reinvestigated with better accuracy. We present a chemical abundance survey of 325 solar neighborhood G dwarfs stars situated within 25 pc from the Sun. We reinvestigate classical observational constraints, namely the metallicity distribution, using a number of chemical elements (Na, Si, Ca, Ni, Fe and Ba) as metallicity indicators. The abundance probability density function for each of the surveyed element was derived using a Gaussian kernel estimator. We have found mean values of −0.11, −0.14, −0.07, −0.05, −0.16 and −0.12 dex for the [Fe/H], [Na/H], [Si/H], [Ca/H], [Ni/H] and [Ba/H] pdfs, respectively. We also show that abundance distributions having higher mean values have smaller dispersion, in contradiction to the predictions of the Simple Model with Delayed Production. We discuss this result in the context and present an alternate explanation for this pattern.

Keywords. Galaxy: evolution – stars: late-type – solar neighbourhood

1. Introduction and Methodology

Studies of chemical abundances of large sample of stars are crucial to formulate a solid theory for the chemical evolution of the Galaxy. With this purpose, we collected spectra for a sample of 325 solar neighborhood G dwarfs. The spectra are centered at λ6145 Å, cover 150 Å, and have a resolution of 0.3 Å. The spectral region was selected in order to cover transitions for a number of elements produced at several different astrophysical sites, owing to their nucleosynthetic history, ranging from alpha elements (Si and Ca), iron-peak elements (Fe and Ni), odd Z-elements (Na) and s-process elements (Ba). All spectra were reduced in the standard way using IRAF. The elemental abundance were calculated using the MARCS model atmosphere described by Edvardsson *et al.* (1993), in a differential analysis with the Sun as standard star. A more thorough description of the observations and data analysis is given in an upcoming paper (Bragança *et al.*, 2010).

2. Abundance Distributions

Figure 1 presents individual generalized histograms for each element studied (except for Fe), for our sample (solid lines) and that of Shi *et al.* (2004)(dash dot lines), Allende-Prieto *et al.* (2004)(dot lines) and Takeda (2007)(dash lines). The generalized histograms

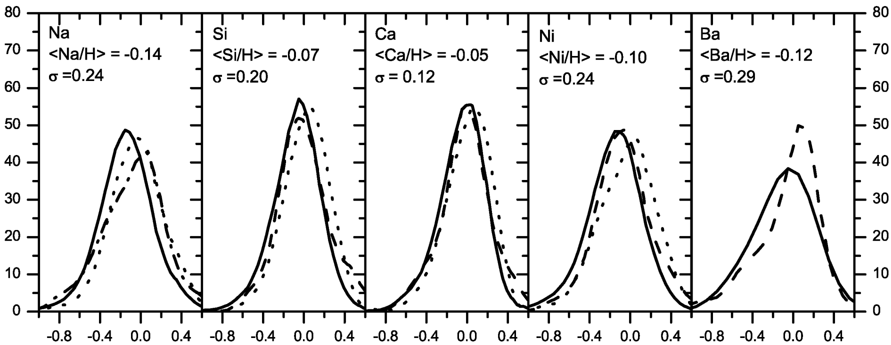

Figure 1. Probability density functions for our sample in comparison with that from other authors. The pdfs constructed using our data is shown by solid lines and that by Shi *et al.* (2004), Allende-Prieto *et al.* (2004) and Takeda (2007) are shown by dash dot lines, dash lines and dot lines, respectively.

are constructed using a Gaussian kernel estimator so the errors on the abundances could be explicitly included in the analysis. It is also shown on Figure 1 the mean value and standard deviation for each of the pdfs. The sample of Shi *et al.* (2004) and Takeda (2007) are composed, in the average, of stars preferentially brighter than those of our sample, explaining the apparent regular shift in the distribution peak of each element. This could indicate that their stars are younger and richer than ours. The sample of Allende-Prieto *et al.* (2004) is more similar with ours because it is volume-complete.

3. Discussion

The mean values and standard deviations of chemical abundances, showed in Figure 1, indicate that elements having larger average abundances present smaller dispersion. The results are inconsistent with simple models for the chemical element in the Galaxy with delayed productions (Pagel, 1989) form whih it can be shown that elements having productions more delayed than a typical SN II byproduct should present larger average abundance and smaller dispersions at the present time. The contradiction comes from the fact that the elements showing this behavior in our data are those mainly produced by SN II (Ca and Si). This discrepancy indicates that other complex processes, such as infall, time varying star formation rate or initial mass function, have affected the abundance distribution of solar neighborhood stars. For more details, see Bragança *et al.* 2010 (in preparation).

References

Allende-Prieto, C., Barklem, P. S., Lambert, D. L., & Cunha, K. 2004, A&A, 420, 183

Edvardsson, B., Anderson, J., Gustafsson, B., Lambert, D. L., Nissen, P. E., & Tomkin, J. 1993, *A&A*, 275, 101

Pagel, B. E. J. 1989, *RMxAA*, 18, 161

Shi, J. R., Gehren, T., & Zhao, G. 2004, *A&A*, 423 ,683

Takeda, Y. 2007, *P.A.S.J.*, 59, 335

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