# Setting a base for further analysis of giant-planet properties orbiting evolved stars

V. Zh. Adibekyan[1], L. Benamati[1,2,3], N. C. Santos[1,2,3], S. Alves[4,5], C. Lovis[6], S. Udry[6], G. Israelian[7,8], S. G. Sousa[1,2], M. Tsantaki[1,2,3], A. Mortier[9], A. Sozzetti[10], and J. R. De Medeiros[11]

email:vadibekyan@astro.up.pt

[1] Centro de Astrofísica da Universidade do Porto, Rua das Estrelas, 4150-762 Porto, Portugal [2] Instituto de Astrofísica e Ciência do Espaço, Universidade do Porto, Rua das Estrelas, PT4150-762 Porto, Portugal
[3] Departamento de Física e Astronomia, Faculdade de Ciências da Universidade do Porto, Portugal [4] Instituto de Astrofísica, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, 782-0436, Macul, Santiago, Chile
[5] CAPES Foundation, Ministry of Education of Brazil, Brasília / DF, Brazil [6] Observatoire de Genève, Universit de Genve, 51 ch. des Maillettes, 1290, Sauverny, Switzerland
[7] Instituto de Astrofísica de Canarias, 38200 La Laguna, Tenerife, Spain [8] Departamento de Astrofísica, Universidad de La Laguna, 38206 La Laguna, Tenerife, Spain
[9] SUPA, School of Physics and Astronomy, University of St Andrews, St Andrews KY16 9SS, UK [10] INAF – Osservatorio Astrofisico di Torino, 10025 Pino Torinese, Italy
[11] Departamento de Física Teórica e Experimental, Universidade Federal do Rio Grande do Norte, Campus Universitário Lagoa Nova, 59072-970, Natal, RN, Brasil

## The sample

Our sample comprises of 256 G- and K-type evolved stars that are being surveyed for planets in the context of the CORALIE exoplanet search program. The stellar parameters and abundances were derived assuming LTE with a grid of Kurucz atmosphere models, and the MOOG radiative transfer code.

The stars in the sample have effective temperatures 4700$\lesssim$ $\mathbf{T_{eff}}$ $\lesssim$5600 *K*, surface gravities 2.2$\lesssim$ **log g** $\lesssim$3.7 dex, microturbulence 1$\lesssim$ $\xi_t$ $\lesssim$3.2 km/s and they lie in the metallicity range of -0.75$\lesssim$[Fe/H]$\lesssim$0.3 dex (Alves et al. 2014).

## Galactic chemical evolution

From Fig.1 one can see that for all the elements Galactic chemical evolution trends for giant and dwarf stars are similar, although for some species [X/Fe] values are shifted towards higher values at a fixed metallicity. Our analysis confirms the overabundance of Na (also Al and Si to a less degree) in giant stars compared to the field FGK dwarfs. This overabundance may have a stellar evolutionary character, even though the possible departures from non-LTE may produce an enhancement of a similar degree.

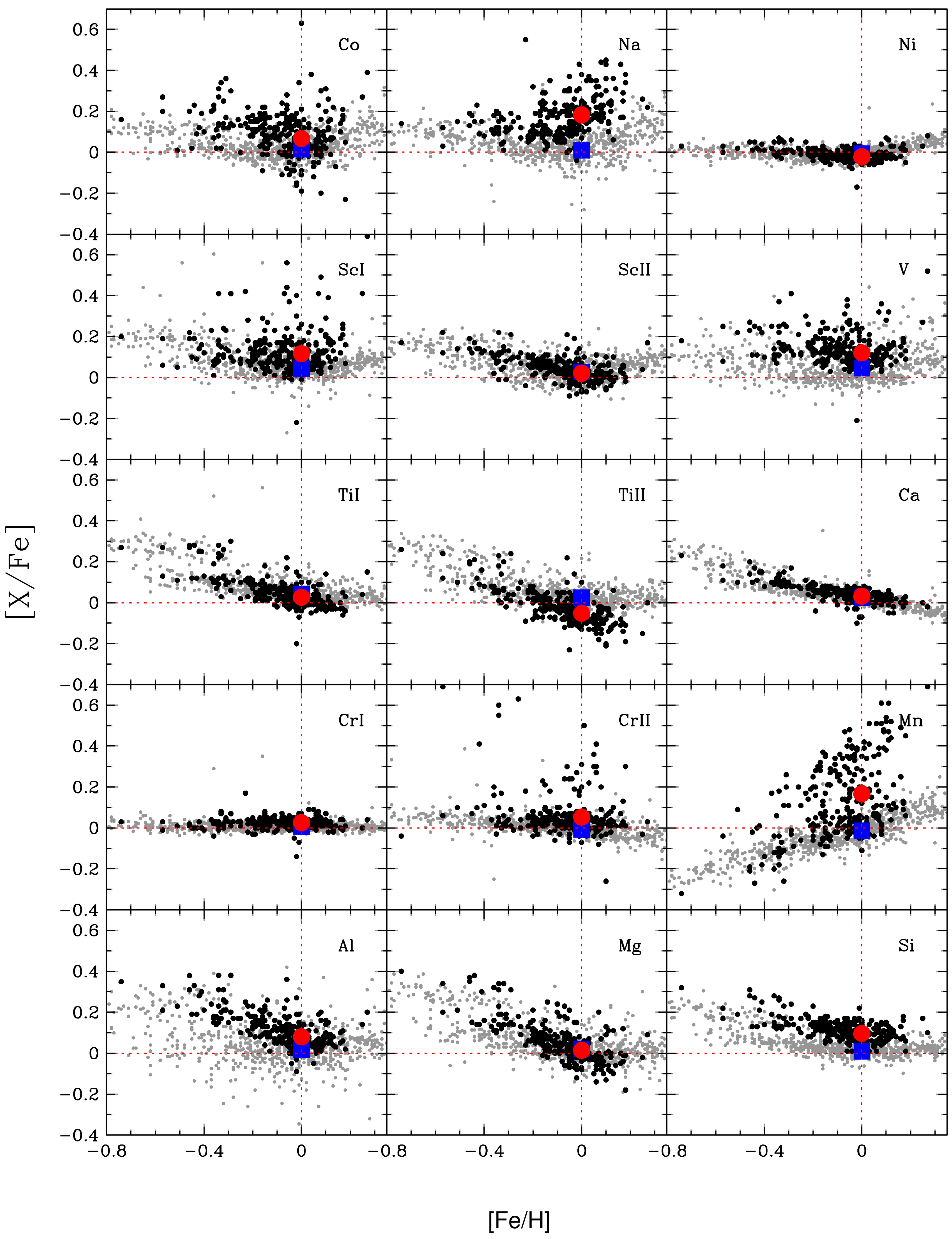


Figure 1: [X/Fe] vs. [Fe/H] plots. The black dots represent the stars of the sample and the gray small dots represent stars from Adibekyan et al. (2012) with $\mathbf{T_{eff}} = T_{\odot}\mathbf{\pm 500}$ *K*. The red circles and blue squares show the average [X/Fe] value of stars with [Fe/H] = 0.0±0.1 dex.

## Acknowledgments

This work was supported by the European Research Council/European Community under the FP7 through Starting Grant agreement number 239953. V.Zh.A. acknowledges the support from the Fundação para a Ciência e a Tecnologia, FCT (Portugal) in the form of the fellowship SFRH/BPD/70574/2010.

## Metallicity distribution

From the right panel of Fig.2 it is apparent that the metallicity distribution of the giants is narrower than that of their non-evolved dwarf counterparts, but peaked at almost solar metallicity as in case of the dwarfs. The lack of very metal-rich and metal-poor stars can be explained by the fact that most of the stars are originated in the solar vicinity. Evolved stellar samples mostly consist of massive stars, which have shorter lifetime than the dwarfs, and do not have enough time to migrate from further inner/outer disks (e.g., Minchev et al. 2013).

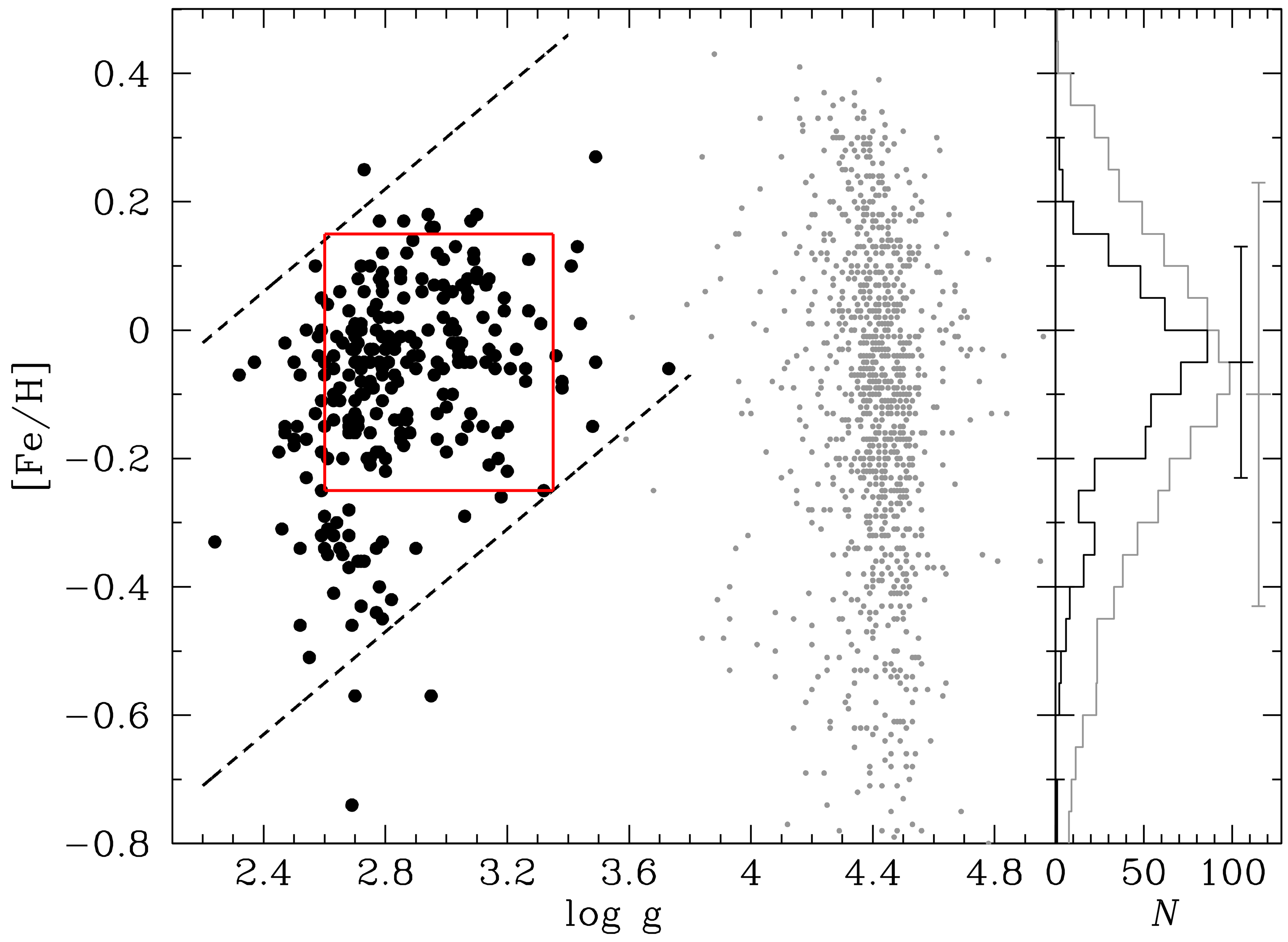


Figure 2: *Left panel*: [Fe/H] vs. **log g** for the current sample (black dots) and for the stars from Adibekyan et al. 2012 (gray dots). The two black dashed lines were drawn by eye and show the biases in the samples due to the B – V cut-off. *Right panel*: The metallicity distribution of the two aforementioned samples. The distribution of the giants stars (gray line) was multiplied by 2 for the better visual comparison. The median and its standard deviation is also presented for metallicity distributions of both giants and dwarfs.

## Perspectives for further planet property studies

Several authors suggested that, in contrast to dwarf stars, there is no correlation between giant planet occurrence and metallicity of evolved stars (e.g. Pasquini et al. 2007, Mortier et al. 2013).

From the left panel of Fig.2 we can see that our present sample, as most of the giant star samples searched for planets, is affected by $B-V$ colour cut-off which excludes low-**log g** stars with high-[Fe/H] and high-**log g** stars with low metallicity. This selection bias might be the reason of the absence of the correlation between occurrence of giant-planet planets and stellar metallicity (Mortier et al. 2013). We suggest to use stars in a "cut-rectangle" in the **log g**–[Fe/H] diagram to overcome the aforementioned issue, if an unbiased sample is not available on hand.

All the stars in this sample have already been periodically observed over the last years. Before a significant number of planets are detected, this sample can be used as a homogeneous comparison sample to study planet occurrence around giant stars.

## References

Adibekyan, V. Z., Sousa, S. G., Santos, N. C., et al. 2012, A&A, 545, A32
Alves, S., Benamati, L., Santos, N. C., et al. 2014, A&A, submitted
Minchev, I., Chiappini, C., & Martig, M. 2013, A&A, 558, A9
Mortier, A., Santos, N. C., Sousa, S. G., et al. 2013, A&A, 557, A70
Pasquini, L., Döllinger, M. P., Weiss, A., et al. 2007, A&A, 473, 979