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T_c-trend and terrestrial planet formation: The case of Zeta Reticuli

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Abstract. Some studies suggested that the chemical abundance trend with the condensation temperature, T_c, is a signature of rocky planet formation. Very recently, a strong T_c trend was reported in ζ^2 Ret relative to its companion (ζ^1 Ret) and was explained by the presence of a debris disk around ζ^2 Ret. We re-evaluated the presence and variability of the T_c trend in this system with a goal to understand the impact of the presence of the debris disk on a star. Our results confirm the reported abundance difference between ζ^2 Ret and ζ^1 Ret and its dependence on the T_c. However, we also found that the T_c trends depend on the individual spectrum used. We conclude that for the ζ Reticuli system, for example, nonphysical factors can be at the root of the T_c trends for the case of individual spectra. For more details see Adibekyan *et al.* (2016b).

Keywords. Planetary systems, stars: abundances, stars: binaries

1. Abundance trends with condensation temperature

During the last decade astronomers have been trying to search for chemical signatures of terrestrial planet formation in the atmospheres of the hosting stars. Several studies explored a possible trend between the abundances of chemical elements and the condensation temperature (T_c) of the elements. This trend is usually called "T_c-trend". A T_c-trend was reported for several binary and field stars (including our Sun - Meléndez *et al.* 2009). While terrestrial planet formation, Galactic chemical evolution and stellar formation/evolution were proposed to explain the observed T_c-trend in Sun-like stars, its real nature is still debated (see Adibekyan *et al.* 2017 for a recent review).

Recently, Saffe *et al.* (2016) reported a positive T_c trend in the binary system, ζ^1 Ret – ζ^2 Ret. The authors explained the deficit of the refractory elements relative to volatiles in ζ^2 Ret as caused by the depletion of about $\sim$3 $M_\oplus$ rocky material. Here we re-evaluated the presence and variability of the T_c trend in this interesting system.

2. The ζ Reticuli system: stellar parameters and abundances

The ζ Reticuli binary system consists of two solar analogs where one of the stars (ζ^2 Ret) hosts a debris disk. Stellar parameters and chemical abundances of the stars are derived (from individual and combined high quality spectra) as described in the following works (Sousa *et al.* 2015, Adibekyan *et al.* 2015, Adibekyan *et al.* 2016a, Delgado-Mena *et al.* 2017).

3. ζ^1 Ret vs. ζ^2 Ret

In Fig. 1 (a) we compare the abundances of the two stars in the ζ Reticuli system against the T_c. There is a clear deficit of the refractory elements elative to volatiles in ζ^2 Ret, that can be related to the presence of the debris material.

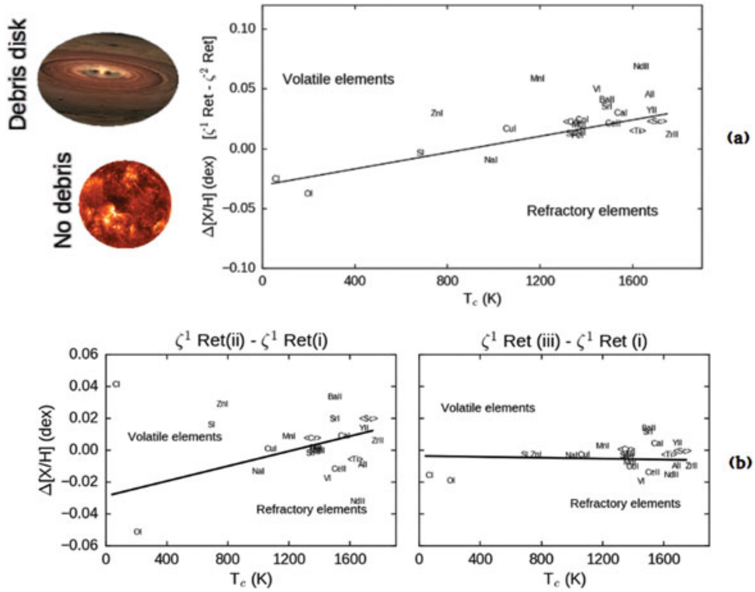

Figure 1. (a) Differential abundances (ζ^2 Ret – ζ^1 Ret) against T_c. The abundances are derived from very high S/N (> 1000) HARPS spectra. (b) Differential abundances against condensation temperature for ζ^1 Ret, derived from three highest S/N (> 350) individual spectra. The black lines are the results of the linear regression.

4. ζ^1 Ret vs. ζ^1 Ret (different spectra, different epochs)

In Fig. 1 (b) we compare the abundances of ζ^1 Ret derived from three individual spectra observed at different epochs. One can see significant but varying differences in the abundances of the same star from different individual high-quality spectra i.e. T_c-trend depends on the individual spectrum used (even if always of very high quality).

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