Chemical Abundances in the Universe: Connecting First Stars to Planets
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Distribution of refractory and volatile elements in CoRoT planet host stars

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Abstract. We report on preliminary results of spectroscopic determination of the atmospheric parameters and chemical abundances of the parent stars of the recently discovered transiting planets CoRoT-2b and CoRoT-4b. We found a flat distribution of the relative abundances as a function of their condensation temperatures. Also, we introduce a new methodology to investigate a relation between the abundances of these stars and the internal migration of their planets.

Keywords. planetary systems, stars:abundances, stars:fundamental parameters

1. Introduction

Gonzalez (1997) and Santos *et al.* (2001) first showed the presence of metallicity excess in stars with giant planets (SWP). The relative distribution of the stellar abundances of refractory elements, with a high condensation temperature (T_C), with respect to the volatile elements (low T_C), has been widely used in the literature as a tool to investigate the nature of the metal enrichment in SWP. In this work we present other interpretation of these gradients by studying the relationship between the metallicity of these CoRoT systems and the migration of the planets resulting from interaction with planetesimals.

Table 1. Stellar parameters of the CoRoT exoplanets parent stars

Star Name	$T_{\rm eff}$ [K]	log g	ξ_t [km/s]	[Fe/H]	v sin i [km/s]
CoRoT-2	5600 ± 150	4.30 ± 0.2	1.50 ± 0.20	-0.04 ± 0.09	8.5 ± 1.0
CoRoT-4	6250 ± 150	4.45 ± 0.2	1.44 ± 0.20	0.13 ± 0.12	5.5 ± 1.0

2. Observations and abundance analysis

The high-resolution spectra of CoRoT-2 and 4 analyzed in this work were obtained with the FEROS echelle spectrograph of the 2.2 m ESO telescope at La Silla (Chile). The nominal S/N ratio was 55-60 after 2 x 3600 s of integration time. Determination of the basic parameters and the abundance analysis were derived in standard approach of the LTE using a revised version (2002), of the code MOOG (Sneden 1973) and a grid of Kurucz (1993) ATLAS9 atmospheres (see Table 1). We determined abundances of 15 elements: O, Li, Na, Mg, Al, Si, S, Ca, Sc, Ti, Cr, Mn, Ni, Zn, Ba and Fe (see Figure 1).

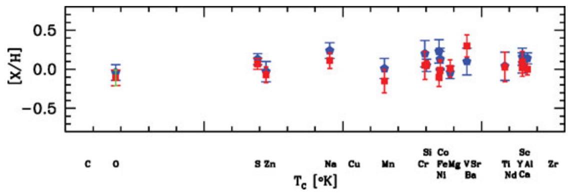

Figure 1. Relative abundances distribution of elements for CoRoT-2 (red squares) and CoRoT-4 (blue circles) stars in function of their condensation temperatures

3. Numerical simulation

We numerically integrated the CoRoT-2 and CoRoT-4 systems, within the circular restricted three-body problem: star-planet-planetesimals. We assumed that large planets observed close to their parent stars actually have been formed at larger distances but migrated inward due to lose energy and excess energy used to disperse the planetesimals. A detailed description of the planet migration used in this work is presented in Winter *et al.* (2007). For simplicity, we assume that in a certain epoch of the disk evolution, more properly between 20-30 Myr, the disk is formed by a sea of planetesimals defining three representative zones: refractory (R), intermediate (I) and volatile (V).

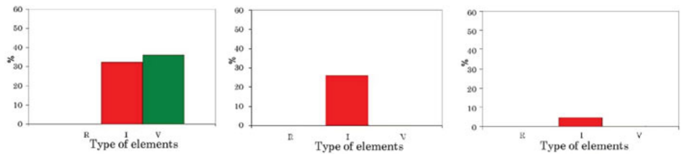

Figure 2. Histogram of the percentage of planetesimals from R, I and V zones that fall on Corot-4 for the case of $a_{P_i} = 5$ AU. Zones: Refractory 0.0.3–0.1 AU, 1780–1360 K; Intermediate, 0.1–1.56 AU, 1360–200 K and Volatiles, 1.56–4.5 AU, $<$ 200 K. The time of integrations are from left to rigth: 100 000 yr, 10 000 yr and 1000 yrs.

4. Results

We present the abundance results in function of T_C for CoRoT-2 and CoRoT-4 stars. We find that a flat distribution is the rule for them. In the case Corot-4 system the accretion shows large and similar contributions of I and V particles and a very small contribution of pure refractory elements as presented in Figure 2. In other words, accretion is mainly "cool" and "warm" and not "hot" as largely mentioned in the literature. In the case of the system 2, an unrealistic large disk mass is necessary to bring the planet to their observed final distance with respect to the star. In adittion, CoRoT-2 star deserves a special attention due to its youth indicators represented respectively by the Ca II H and K lines and its strong Li resonance line. This age can be obtained by means of the equivalent width (EW) and abundance of Li. Considering all these matches, we infer an age of 120 Myr for CoRoT-2.

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