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# The metal–poor end of the Spite plateau

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**Abstract.** We present the largest sample available to date of lithium abundances in extremely metal poor (EMP) Halo dwarfs. Four $T_{\rm eff}$ estimators are used, including IRFM and H$\alpha$ wings fitting against 3D hydrodynamical synthetic profiles. Lithium abundances are computed by means of 1D and 3D-hydrodynamical NLTE computations. Below [Fe/H]$\sim$−3, a strong positive correlation of A(Li) with [Fe/H] appears, not influenced by the choice of the Teff estimator. A linear fit finds a slope of about 0.30 dex in A(Li) per dex in [Fe/H], significant to 2–3 $\sigma$, and consistent within 1 $\sigma$ among all the $T_{\rm eff}$ estimators. The scatter in A(Li) increases significantly below [Fe/H]$\sim$–3. Above, the plateau lies at $\langle \mathrm{A(Li)}_{\rm 3D,NLTE}\rangle = 2.199 \pm 0.086$. If the primordial A(Li) is the one derived from standard Big Bang Nucleosynthesis (BBN), it appears difficult to envision a single depletion phenomenon producing a thin, metallicity independent plateau above [Fe/H] = −2.8, and a highly scattered, metallicity dependent distribution below.

**Keywords.** nuclear reactions, nucleosynthesis, abundances, Galaxy: halo, Galaxy: abundances, stars: abundances, stars: Population II

## 1. Introduction

In this work we present lithium abundances for a sample of 28 stars in the −3.6<[Fe/H] <−2.4 range, 10 of which have [Fe/H]$\leqslant$ −3.0. All the stars were observed with UVES@ VLT with S/N$\sim$80–100 in the Li doublet range. We employed four temperature scales: H$\alpha$ wings fitting against a grid of synthetic profiles from 1D models using Barklem *et al.* (2000) or Ali & Griem (1966) self-broadening theories (BA and ALI scales); H$\alpha$ fitting against a 3D-hydrodynamical grid based on CO$^5$BOLD models (Freytag *et al.* 2002, Wedemeyer *et al.* 2004) with Barklem *et al.* (2000) self-broadening (3D scale); InfraRed Flux method (IRFM, González Hernández & Bonifacio 2009). Fe I and Fe II lines were used to establish metallicity and set gravity and microturbulence. Hydrodynamical 3D spectral synthesis was employed together with an 8-levels Li model atom to derive 3D NLTE Li I 670.8nm doublet line profiles (see Sbordone *et al.* (2009) for details).

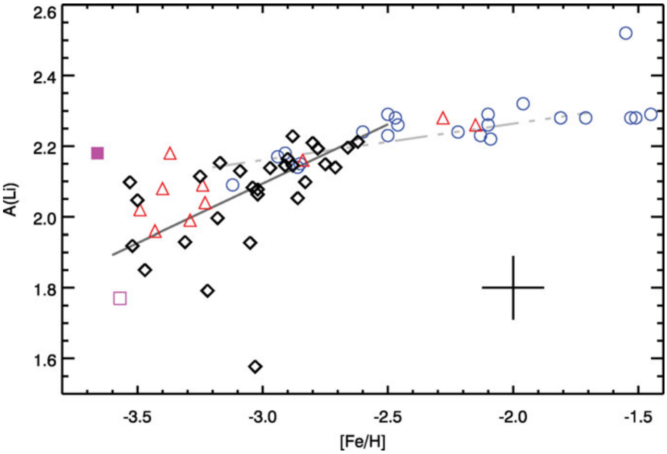

**Figure 1.** A(Li) vs. [Fe/H] from some recent studies. Blue circles, Asplund *et al.* (2006) data, red triangles, Aoki *et al.* (2009) data, magenta squares, CS 22876–032 from González Hernández *et al.* (2008), filled symbol primary star, open symbol secondary star. Black diamonds, this work, BA temperature scale. Dot-dashed gray line, best linear fit to Asplund *et al.* (2006) data, continuous dark gray line, best fit to our data. Typical error bars for our data are displayed.

## 2. Results

Although up to 400 K difference in $T_{\rm eff}$ exist between the coolest scale (BA) and the hottest (ALI and IRFM), the results are remarkably similar. In all cases, a linear fit in the A(Li) vs [Fe/H] plane bears a strong positive slope of about 0.3 dex in A(Li) per dex in[Fe/H], significant at 2–3 $\sigma$ and consistent within 1 $\sigma$ among the four scales. Lithium abundances scatter increases significantly at [Fe/H]$<-3.0$, while a thin plateau exists above this metallicity (see Fig. 1). The low-metallicity distribution appears roughly triangular, with some stars staying at (or close to) the plateau value, and others showing Li depletions which are in general larger at lower metallicities. No star is found above the plateau level: this asymmetric increase in the scatter leads to the slope observed in the linear fit. It appears thus that the Spite plateau is progressively disrupted below [Fe/H]$\sim-3$, where an increasing number of stars show significantly sub-plateau A(Li). We suggest a two process scenario to explain this finding: i) the stars in our sample have all formed with a Li content corresponding to the plateau (be it the primordial value, or the result of some previous depletion) and ii) some further (atmospheric?) depletion process acts preferentially on more metal poor objects, but becomes negligible above [Fe/H]$\sim-3$.

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